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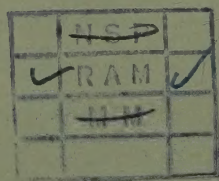
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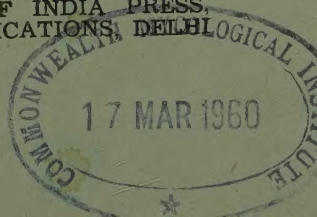
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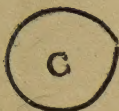
ANNUAL REPORT
OF THE
INDIAN COUNCIL OF
AGRICULTURAL RESEARCH
FOR
1955-56



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ANNUAL REPORT
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1887



ANNUAL REPORT

OF THE

BOARD OF DIRECTORS
OF THE
SOUTHERN RAILROAD

1887

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SUMMARY

The activities of the Council comprised of agricultural research, agricultural education and agricultural information. The following paragraphs give the salient features of the activities of the Council in these fields.

RESEARCH

Agriculture

The Council continued to sponsor schemes of research in various fields of agriculture, horticulture and related subjects.

The scheme connected with the introduction of suitable economic plants was continued at the Indian Agricultural Research Institute.

The work relating to physiology and cytogenetics of certain plants was in progress at various places as also the problems relating to hormones and micro-nutrients.

Inter-spacing hybridisation of rice was in progress at the Central Rice Research Institute. Breeding for saline and flood resistant paddy was also continued.

A selection for suitable varieties of paddy for high altitude areas was undertaken. The incidence of paddy stem-borer in relation to different weather conditions was under observation. Studies were also undertaken on the seasonal incidence and activity of paddy stink bug as also those of rice hispa. The source of infection of helminthosporium was under study.

Work relating to rust-resistant seedlings and adult plants of various wheat varieties, both exotic and indigenous, was continued at the Indian Agricultural Research Institute and also at other research centres. Work on inter-varietal crosses of wheat was also taken up in certain research stations including the breeding of rust resistant wheat. A survey was undertaken to observe the incidence of foot-rot disease of wheat.

Selection and breeding work on barley and various millets were in progress in different regions. Various Indian and exotic varieties of millets were maintained and multiplied at the Indian Agricultural Research Institute. The work of hybrid maize was continued. Plants of 88 inbred lines imported from U.S.A. were multiplied and single cross parents of late or early double crossed hybrids were produced.

Many projects of research work on various pulses were in operation in various parts of the country.

Under the Grassland Survey Scheme, survey work was undertaken in several States. Termite research schemes were in operation at the Indian Agricultural Research Institute, Forest Research Institute and at Anand. The study of the virus diseases was continued at the Indian Agricultural Institute. Virus diseases of certain fruits and vegetables were investigated.

Horticulture

Varietal collections of sweet potatoes were made and agronomic work undertaken in certain States. Trial work on some vegetables was also undertaken.

Varietal cytological studies on mango as also root stock and manurial trials of citrus fruits were undertaken. Investigations were also carried out on certain other fruits like grape, guava, custard apple, etc.

In various cashewnut growing States, a survey was made of cashewnut growing areas and morphological details of tree leaves, flowers and fruits were recorded. Some agronomic trials were also undertaken.

Medicinal plants

Experiments for the cultivation of certain medicinal plants were undertaken at the Forest Research Institute and in Jammu and Kashmir State, Bengal and Assam.

Agricultural implements

A survey of agricultural implements in various States was continued. The survey of indigenous agricultural implements was completed in certain States. It was, however, continued in the remaining States.

Animal Husbandry

Breeding: A scheme for evolving a dual purpose animal by scientific breeding was continued at Hissar. Work was undertaken with the object of improving milking qualities of Kangayam cows without adversely affecting the draught capacity of the males of the breed. Investigational work on the improvement of Ghumsar cows was in progress.

At the Central Artificial Insemination Centre, the actual work of collection of semen was started after September, 1955. The bulls were trained and it was observed that about 4 c.c. of semen could be collected from each ejaculate.

Studies on the various types of semen shippers revealed that the container designed by the Indian Veterinary Research Institute was most suitable for air-lifting of semen.

The co-ordinated scheme of research on cross breeding of non-descript cattle in heavy rainfall and hilly areas with Jersey bulls to improve their milk qualities was in progress. Work was undertaken at Haringhata on the physiological genetics of different breeds of Indian cattle in adverse climatic conditions.

The co-ordinated scheme for the improvement of sheep and wool production on a regional basis was continued in various centres located in each region of the country.

Work of testing wool samples were carried out in different wool laboratories. Work on the improvement of goats was also carried on. A scheme with the object of evolving Mohair yield strain of goat by crossing the local white hairy goats with the imported Angora Bucks was in operation.

Schemes for the improvement of poultry in different regions were continued. Steps were taken both to upgrade the indigenous breeds as well as the introduction of foreign varieties.

Animal nutrition

Nutritive qualities of various leafy fodders were investigated. The influence of trace elements on the health and productive capacity of livestock was under observation. The study of nutritive value of paddy straw was continued. Work was undertaken to study the effects of humid climate of Bengal on Haryana cattle.

Diseases

The scheme for the development of suitable vaccine for the control of Foot and Mouth disease was continued at the Indian Veterinary Research Institute. A co-ordinated scheme for the investigation of bovine mastitis was in operation in several States and also at the Indian Veterinary Research Institute. Comprehensive investigations on the incidence of tuberculosis and Johnes disease with a view to devising ways and means of diagnosis for control of this disease were undertaken at the Indian Veterinary Research Institute. Work was undertaken to study the life history of certain helminth parasites affecting livestock. The work included the study of their pathogenicity and developing suitable methods of control.

The pilot projects for the eradication of rinderpest from the peninsular India was in operation. The work of mass production of vaccine and mass vaccination of animals in the States covered by the Scheme was pursued vigorously. Upto the end of March, 1956, 95,02,290 doses of rinderpest vaccine were produced at the Indian Veterinary Research Institute and 71,67,185 doses supplied to the States. Upto the end of March, 1956, 52,99,499 cattle and buffaloes, were vaccinated and marked in various States.

STATISTICS

The statistical branch of the Council continued its advisory work relating to design of agricultural and animal husbandry experiments and the interpretation of their results. The Branch also examined the technical programmes and annual reports of the Council's schemes from the statistical point of view. A number of enquiries received from the Food and Agricultural Organisation of the United Nations Organisation, Central Government, State Governments and other institutions were also dealt with. Post-graduate training courses in agricultural statistics were continued as usual.

A training centre in agricultural statistics was established in January, 1955 under the joint aegis of the Indian Council of Agricultural Research and the Directorate of Economics and Statistics for training State Revenue and Land Record Officers with a view to acquaint them with new standard definition and concepts in improved methods of collecting and compiling agricultural statistics.

A refresher course for senior research officers responsible for planning and guiding research in the field of agriculture in the States and the Central Institutes was conducted by the Statistical Wing in February, 1956.

AGRICULTURAL AND VETERINARY EDUCATION

The following steps have been taken to increase the output of trained personnel in agricultural and veterinary sciences:

Agricultural education

- (i) Expansion of training facilities at four of the existing agricultural colleges.
- (ii) Establishment of three new agricultural colleges one each in Rajasthan, Bihar and Travancore-Cochin.
- (iii) Rehabilitation of the Punjab Agricultural College.

Veterinary education

- (i) Starting four new veterinary colleges one each in Andhra, Orissa, Travancore-Cochin and Madhya Bharat.
- (ii) Extension of training facilities in six of the existing veterinary colleges.
- (iii) Starting double shifts at five of the existing veterinary colleges.
- (iv) Institution of two year diploma course in veterinary science at ten centres in various parts of the country.

In order to strengthen the existing agricultural and veterinary institutions, the Government of India have developed inter-institutional arrangements with five United States Universities on a regional basis. Under this arrangement, India has been divided into five regions and each contracting institution in U.S.A. will co-operate with the States in the region allotted to them by providing technical assistance.

A joint team of Indian and American specialists was appointed by the Government of India to make a comparative study of the organisation, function and working of the Indian and American institutions engaged in agricultural education and research and to make recommendations for removing some of the critical deficiencies in the existing facilities for agricultural research and education. Most of the recommendations of the team has been accepted by the Government in principle and steps are being taken to implement them as early as possible.

AGRICULTURAL INFORMATION

The Council continued to publish a number of scientific journals, monographs, bulletins and pamphlets. On the non-technical side, *Indian Farming*, *Kheti*, *Dharti-ke-Lal* were continued, as also the series called *Farm News Releases*.

CHAPTER I—ADMINISTRATION

GENERAL

This is the 26th Annual Report of the Indian Council of Agricultural Research presented by its Governing Body, under rules 64 of the Rules of the Council giving a general review of the activities of the Council during the year 1955-56.

OFFICIAL CHANGES

During the year under report Shri M. S. Randhawa, I.C.S. took over charge of the office of the Vice-President of the Council *vice* Shri K. R. Damle, I.C.S.

The following additional appointments were made:

- | | |
|--------------------------|--------------------------------------|
| (1) Shri P. M. N. Mandu | Deputy Animal Husbandry Commissioner |
| (2) Shri R. K. Ram | |
| (3) Shri Ajudhia Prasada | Under Secretaries |
| (4) Shri R. B. Mohindra | |

ALLOTMENT OF FUNDS

The Council which influences agricultural Research in Co-operation with the States, Universities and private Institutions sanctioned the continuance of 52 current schemes at a cost of 19·64 lakhs (Appendix II). During the year, it also sanctioned 116 new research schemes in agriculture, animal husbandry, statistics, etc., involving a total cost of 59·08 lakhs (Appendix III). Fifty four schemes terminated during the year (Appendix IV).

FINANCE AND ACCOUNTS

The following were the receipts from (i) the cess levied under the Agricultural Produce Cess Act, 1940, (ii) the grants received from the Government of India, and (iii) grants from other sources:

	Rs.
I. Receipts from the cess	49,12,414
II. Grants from the Government of India for the following schemes:	
1. Weed control	32,200
2. Manurial trials	56,100
3. Cattle sterility	1,23,500
4. Improvement of fishery and livestock statistics	1,18,000
5. Agricultural publicity	2,68,500
6. Sample survey for the estimation of area of yield and pepper	49,880
7. Research and development of pepper and Cashewnut	1,84,865
8. Study of milk yields and management practices of Bovine in Northern India	39,000
9. Japanese method of Paddy cultivation	45,000
10. Improvement of land records and agricultural statistics	17,640

III. GRANTS FROM OTHER SOURCES:

(A) Ford Foundation	Rs.
(i) Publication of <i>Dharti-Ke-Lal</i>	55,500
(ii) International Farm Youth Exchange	3,800
(B) Contribution from Indian States	
(i) Jammu and Kashmir	5,000
(ii) Travancore-Cochin	5,000

A statement showing the audited accounts of the Council for 1955-56 is appended (Appendix XVI).

MEETINGS

Seventy-eight meetings of the various bodies of the Indian Council of Agricultural Research were held during the year under report (Appendix I).

CHAPTER II—AGRICULTURAL RESEARCH

BOTANY

At the Vivekananda Laboratory, Almora, trials with 10 varieties of garden pea were undertaken. From the results of trial conducted so far, the variety *Miller* has been found to be the most suitable for this region. It is a very early variety and has been consistently giving high yields. Among the varieties of Beans, *Tride*, *Snap Bush* and *Rival* have proved very successful on account of their short life cycle. *Artemisia brevifolia*, *Pyrethrum* sp., and *Urginea maritima* were introduced in the Hawalabag Farm.

A special collection of summer vegetables like *bhindi*, bitter-gourd, pumpkins, cucumbers, etc. were made from various seed samples of cultivated plants at the Indian Agricultural Research Institute, New Delhi. Samples of wild growing materials numbering 104 and consisting of *Sesamum* sp., *Abelmoschus* sp., *Vernonia anthelmintica*, *Solanum* sp., *Melilotus philippinensis*, *caesalpinia coriaria* and various grasses were also collected.

The following is the classified list of material imported at the Indian Agricultural Research Institute during the year under report:

Group	Crops	Country from where imported	No. of samples
1	2	3	4
Cereals	Wheat, oats, rye, maize, barely	F. A. O. (Rome), Italy, Canada, U. S. A., Cyprus, Nepal, Australia, Switzerland, France, Israel, Holland, S. Rhodesia, Africa, Iraq, Peru	764
Millets	Pearl millets, sorghum, Eleusine	England, U. S. A., East Africa, Australia, S. Rhodesia	59
Pulses	Cowpea, soyabean, Peas	U. S. A., New Zealand, Norway, Germany, England, Australia, S. Rhodesia	117
Oil-yielding plants	Groundnut, linseed, brassica, sunflower	France, U. S. A., Kenya, Holland, Sweden	38
Fibre-yielding plants	Cotton, <i>Pectino-phaea gossypiella</i>	Iraq and Peru	3
Vegetables and fruits	Tamato, chilli, onion, okra, radish, carrot, beet, spinach, chicory, endive, gherkins, broad-beans, water-melons, luffa, cabbage, cauliflower, lettuce, Dolichos beans, artichoke, Strawberry.	U. S. A., Germany, Canada, England, Australia, Israel, Hawaii, Sweden, Turkey, Iraq, Pakistan, Holland	346

Group	Crops	Country from where imported	No. of samples
1	2	3	4
Root and tuber crops	Sweet potato, pachyrrhizus, swedes	U. S. A., Japan, Ceylon Hawaii, Pakistan	9
Grasses	Sudan grass, <i>Pennisetum</i> , Russian comfrey (<i>Symphytum peregrinum</i>)	U.S.A., England	9
Legumes	<i>Medicago</i> , <i>Lupine</i> , <i>vicia</i> , <i>Lathyrus</i> , <i>Canavallia</i> , <i>Glycine</i> , <i>Kerstingiella</i> , <i>Melilotus</i> , <i>Phaseolus</i> , <i>Pueraria</i> , <i>Rhynchosia</i>	U. S. A., Libya, Australia, U.K., France, Canada, Holland, Germany	34
Wild relatives of cultivated plants.	<i>Solanum</i> , <i>Vigna</i> , <i>Ipomea</i> , <i>Allium</i> , <i>Abelmoschus</i>	Japan, U.S.A., Australia	7
Other miscellaneous plants.	<i>Rumex hymenosepalus</i> , <i>Araucaria aratcana</i> , <i>Kapolk</i> , <i>Simmondsia chinensis</i> , <i>Plantago</i> spp.	U. S. A., Japan, Thailand, Australia	71
Crop varieties, vegetables and pastureland species	Ornamental forage	Australia	794
TOTAL			2,251

The introduced material is under trial and suitable ones will be utilised for breeding economic varieties.

Cytology and embryology

A reinvestigation of *Isomeris arborea* at Delhi University has shown that almost all the peculiar claims made by Billings (1937) regarding this plan are incorrect. Nucellar polyembryony has been reported in some species of *Opuntia* but in *O. dillenii* (a native of India) this phenomenon was overlooked by Tiagi (1954). As embryological studies of *Mangifera indica* had been carried out on a number of foreign varieties and such a work on Indian varieties was almost wanting, a study was undertaken in order to fill up this gap. Polyembryony has been recorded in many of these varieties. Gram was selected for studies on the mechanism of induction of polyploidy by colchicine of Indore. There were two sets of treatments. One set after soaking for four hours in distilled water was germinated in the usual way in petridishes lined with ashless filter paper. The seeds were kept moist by frequent addition of distilled water and germination was continued for seven days. This set constituted the control. Another set was also germinated in the same way but the seeds before germination were treated with 0.08 per cent colchicine solution for 24 hours to induce polyploidy. This concentration was selected after a few trial experiments made with different strengths of colchicine. The nature of polyploidy was determined by staining the chromosomes of root tips by Feulgen

Method. It was found that with this concentration and time the cells became tetraploid. For quantitative chemical studies, weighed amount (5 gm.) of seeds were taken. The enzymatic studies were carried on daily for seven consecutive days. For cyto-chemical studies, after every 24 hours, sections of the radicle, cotyledons and plumule of the grasses were cut and enzymatic activity in these portions was studied by using different techniques.

Plant physiology

The hormone content of the *Rupsail* variety of rice (*Oryza sativa*) was studied in detail at Cuttack. The free auxin of the plant was extracted either by water or by either at low temperature (4°C.) over a long period. A better yield of auxin was obtained with water extraction. The auxin content at the apex, ear and stem was determined at different stages of the development by root-inhibition test. A considerable amount of auxin was found to accumulate in the developing ear, the quality of which rapidly increased with size and weight. Before floral initiation, a considerable amount of auxin accumulated in the compact stem (crown). With extension growth, both total quantity and concentration of auxin in the crown tissue was found to decrease rapidly. Some amount of auxin, however, was left in the crown tissue after termination of stem growth. Young nodes contained much higher concentration of auxin than that present in the internodes. These facts lend support to the assumption that auxin concentration of nodes regulates the extension growth of cereals.

A study on physiology of pollen tube growth in relation to pH range and chemicals including micro-nutrients, vitamins and hormones was done. The following plants were under study: *Penisetum typhoid*, *Gossypium herbaceum*, *Arachis hypogea*, *Solanum melongena*, *Capsicum annum*, *Zea mays*, *Hordeum vulgare*, *Brassica nigra*, *Triticum vulgare* and *Solanum tubersum*.

Experiments were carried out at Almora to determine the effect of incorporating optimum micro-concentrations of different vitamins and amino-acids in the germinating medium (12.5 per cent sucrose solution) on the growth elongation of washed pollen grains of *Madonna Lily*. All the vitamins and amino-acids used in the experiment were found to stimulate the growth of pollen dust adhering to grains containing some growth stimulating substances. Pollens of 24 strains of maize (7 inbreds, 4 single crosses, 11 double crosses and 2 open pollinated varieties) were used to find out the concentration of agar in the germinating medium for maximum germination and elongation of pollen tubes. It was found that generally the pollen of early and low yielding varieties of maize require lower concentration of agar in the medium for the germination and growth elongation. The garden pea pollen has been found to germinate best in a 10 per cent sucrose solution containing 1 per cent agar. In case of mustard seeds (var. T 102), subjected to darkness for 10 days at Almora, it was found that it significantly reduced the size of cotyledons in case of both controlled and vernalised seeds. The cotyledons from seedlings raised from vernalised seeds were found to be smaller than those from control seedlings.

The effect of chilling of seeds of wheat, Pb. 228, for seven weeks in 27 different solutions—4 of major elements, 11 of trace-elements 8 of phenoxy-compounds, 2 of maltose and 2 of colchicine, the life

cycle of plants was observed. Seeds vernalised with molybdenum and maltose produced plants which flowered 6.1 days and 9.9 days earlier as compared to plants from control seeds.

The effect of presoaking of wheat, Pb. 228, for 72 hours in 20 different solutions of major elements, trace elements, phenoxy-compounds and colchicine on the life cycle of plants were also observed. Plants soaked in boron 30 p.p.m. gave maximum earliness (3.5 days) as compared to those from seeds soaked in GWD followed by KNO and molybdenum (2.9 days).

RICE

Interspecific hybridisation

Sixty four new *indica* types selected by the states were sent to Central Rice Research Institute for crossing with two new *japonica* varieties. Out of these during the year 1954, 692 crosses between the *indica* and *japonica* were attempted and 2,676 crossed seeds were obtained. With this year's work at Central Rice Research Institute, 60 out of 128 cross combinations, scheduled under the extended programme, have been completed.

Hybrids of 21 cross combinations were back crossed to the respective *indica* parents and 12-20 back crossed seeds in each set were obtained.

Twelve hundred plants from 64 cross combinations and 500 back cross generation plants were examined and studied. Approximately 3,17,000 seeds for growing F₂ generation and 88-500 seeds for growing mack cross 2 and back cross 3 generations were distributed to the participating States. F₂, F₃ and F₄ generations of several cross combinations were studied and 681 selections from the F₂, 432, F₃ and 274 and F₄ generations were carried forward.

Breeding for salt and flood resistant paddy

Fifty-nine types and 178 hybrid cultures received from Samalkot were raised on the Masulipatnam station for study under saline condition. Out of the varieties tested against salinity, Veluthan, Kuthir, Padni and Nerkonder, Kaluata showed more resistance than controls. Cultures 20389 and 20320 had average stand and growth similar to the controls. During the second crop season, out of the 17 types and 27 cross progeny cultures Studied T. 393 type alone had satisfactory growth and stand, while all the cross progeny cultures completely succumbed to the saline conditions. Among the varieties studied in the second crop season, MTU-9 recorded remarkable yield. This variety also gave better yields in the plots where others failed to grow or gave very low yields.

A total collection of 1125 varieties were made against saline resistance in West Bengal (1955). A preliminary trial, with 13 promising fairly resistant types selected from local materials, along with the two standards (Patnai-23 and S. R. 26B) was undertaken at Goaba-Kumargore though topped the list giving 40.87 maunds per acre was practically identical with Patnai-23 and was superior to varieties Pakkai, Asra X Patnai-84 and Devoiddi.

Five varieties including the standard, Patnai-23, were transplanted in pots with two replications. There were 5 treatments *e.g.*, 0, 0.50, 0.75, 1.00, 1.50 of NaCl. The solutions were added as and when necessary but a water level of about three inches from the soil surface was always maintained. It was observed that some of the types were fairly resistant to a high degree of salinity except Sadamota, which failed to survive at a high degree of salinity. The yield was however very poor and negligible in all the cases in West Bengal (1955).

A collection of varieties from flood affected areas were made at Bengal and Assam (Kalimpong, 1955). A collection of 254 types of Bao paddy were made and were grown for observation. A detailed study of the following characters of all the types were made, height of plants, number of tillers, length of ear, life period and yield.

Six Aman (deep-water winter paddy) types were compared and they were arranged in the following order according to their performance: Kakura Bao, Jara Bao, Sail Badal, Thusi Bao, Hupali and Aman No. I. Nine varieties of paddy were followed to undergo submersion tests separately. In the first test, the types were exposed to gradual rise of water up to 10 ft. 2 inches while in the second test, the water level rose gradually up to 4 ft. from where it rose abruptly to 9 ft. Out of these 9 types only Negheri, Kalongi and Jaulia were able to withstand the rise of water in the first test. In the second test, type Negheri alone could withstand the sudden rise of water level and the rest died.

Four varieties of paddy, (Negheri, Kholihoi, Rangatao and Kakao) were tested in three different areas, *viz.*, Mazuli, Bapeta and Dharmtul (Assam) which were typically flood affected belts. All the types tried at Mazuli were totally damaged by the flood water, while at Bapeta only Negheri could thrive under high flood level. In Dharmtul, all the types grew more or less equally in spite of the sudden rise of flood water in the early stages of crop. Negheri produced the highest yield.

Two crosses between Sali (winter-transplanted paddy) and Aman (winter-broadcast paddy) were tried so as to evolve high yielding varieties of flood resistant paddy. A very small quantity of seeds was obtained from these combinations.

A pot culture trial, with six flood resistant types, including the standard F. R. 43B (collected from Orissa) was undertaken at Chin-surah (West Bengal, 1955). There were 3 levels of deputs 2 ft., 4 ft., and above 4 feet, and 4 levels of duration of submergence, *i.e.*, 7, 14, 21 days, 21 days and 30 days, thus giving 12 treatments for each type, apart from the control set that kept in the field under normal conditions. It was observed that F. R. 134 and Ora could withstand submergence to a certain extra F.R. 13A withstood for 14 days submergence up to 4 feet, and Ora for 7 days up to 2 feet. F. R. 43B survived even after 21 days submergence to a depth of 4 feet. but could not recoup and died three days after the pots were lifted from the tank. The recoupment period for the plants after their removal from water varied for different types. The yield was poor in all the cases except in the case of control.

Improvement of Boro paddy in West Bengal

Last year's 250 types were grown in plots for selection. Chinsurah Boro I stood first among them giving 30.94 maunds per acre. Yield trials with 10 varieties, viz., Assam, I, II, IV, Dharai, Marichbutti, Bhutmuri, DI-III, DI-IV, Kakurai and Chinsurah Boro No. I were undertaken. The highest yield was recorded by Chinsurah Boro No. I and this was significantly superior to others. From a scrutiny of two year's results, it was seen that Chinsurah Boro No. I, a Bhurmuri can be grown safely both under Boro and Aus seasons. Chinsurah Boro No. I did well on the cultivator's plots at Ghatal. This one and the local were superior to others. This showed that the variety Chinsurah Boro No. I was not only suitable for Hooghly where it was evolved but for Midnapur as well.

Chinsurah Boro No. I gave the highest yield of grain when grown during the Aus season in West Bengal (1955). Seven improved Aus varieties were grown at Chinsurah with three promising Boro varieties to study their performance. From grain yield it appeared that the Aus varieties, viz., Kele Jhanji-34 and Charnock could also be grown as Boro crops.

Rice breeding

One hundred and ninety varieties were collected in Coorg (1955). These included some varieties from Mysore, Hyderabad, Madras and Thailand. Kiribiliya-1, a local variety, was crossed with four *japonica* varieties at the Central Rice Research Institute, Cuttack and F1 seeds were sent to the station at Coorg for selection. Selections were made from these F2 generation plants.

From the F3 population of 12 crosses between some *japonica* types and '349 Jhona', 1435 best, single plants which had more or less the same maturity period as '349 Jhona', were selected. About 1.5 dozen new crosses were attempted between the existing approved types and some strains obtained from the other States and abroad. Crossed grains, numbering 67, obtained from these will be raised for F1 generation in the coming season.

Improvement of high altitude paddy

Two hundred and seventeen varieties (collected from all places) were grown during the year under review at Kalimpong and Darjeeling. Most of the types belonging to the plains were found to be unsuitable for the hills, because of their excessive vegetative growth, poor seed setting and susceptibility to disease and drought. In a preliminary yield trial, Mansarah and Nepali Tulsi gave the highest yield of 26 md. per acre. Next came Phaural and Ramtulsi. In a replicated varietal trial the highest yield was recorded by a Chinese variety at C.N.A.B. 4 which was identical with Aday, Kalomaishi and Ramtulsi varieties in yield.

Collection of both wet and dry types was made from different hill districts of Assam (1955). A total of seventy types were available for study. These included a few from outside States. Out of the 79 wet-land types, only very few gave good results. Out of the 13 up-land types only six were found to be successful.

The collection of 220 samples made last year from Madhya Bharat (1955) was grown in the field and 800 individual plants were selected at Bhagwai.

In one trial, 49 strains from West Bengal were tried along with T-21 and Bhopalpatti as control in a replicated progeny row. A few of the high yielding ones are Kalamkatti, 1159 N.C., Nanya 1394 and Panchakalyan 1475 N.C.

Breeding for disease resistance

At Coimbatore, a total of 123 promising cultures from eleven crosses was under comparative trials against the corresponding susceptible parent strains. Sixty-nine cultures have recorded significantly higher yields than the respective standards. At Aduthural, the superiority of these cultures could not be established due to late planting of 129 cultures.

The cultures 6517 and 6522 both from the cross Co. 13 $\times$ Co. 4 were under trial in the districts against Co. 13 standard and other short duration varieties. Culture 6522 recorded higher yield than the control in all the centres. This culture is more or less of the same duration as Co. 13.

A total number of 13,141 segregating progenies of crosses between Co. 4 and other popular but susceptible strains were under the disease bombardment test. Out of these, 4,081 resistant plants as evidenced by the absence of neck infection, were carried forward for further study.

Out of the 60 types suitable for the central districts and seven types suitable for Tanjore, Tiruchirappalli and South Arcot districts (when grown under disease-bombardment) 35 types of the former showed less than 10 per cent infection and six per cent of the latter showed promise in respect of disease resistance.

At the Paddy Breeding Station, Coimbatore, 36 departmental strains were arranged into three groups according to their duration, and were planted in six monthly planting series, commencing from sowing done in August planting done in September, and ending with sowing in January and planting in February. The incidence of disease recorded for the short duration strains showed that the infection was more in all the strains planted in October, and November and December plantings recorded low incidence. In the case of medium duration strains, the planting done in September and October showed very severe infection, whereas lesser infection was recorded in other plantings. The strains planted in January and February failed to produce any ears.

A total of 1088 apparently blast-resistant progenies, belonging to the eight different crosses (Co. 4, B.C.P. 1, B.C.P. 2, B.A.M. 6, Slo. 17, Mol. 1834, Co. 25, Co. 19), were planted during the year. A total of 159 promising, blast-resistant, hybrid progenies were selected during this year, from all the crosses for small-scale tests in the ensuing season. Out of 85 progenies received from outside, 23 were selected as promising, which include 75/2, 174, 1287, 1729 and 1771. From the comparative yield trial of the progenies with Mol. 1834 as control, eight cultures, which gave higher yields than the control, were selected.

Manurial experiments were conducted to study the effect of fertilizer on the yield of paddy crops at high altitudes at Upper Shillong Farm, Assam. Three treatments on control, ammonium sulphate at 20 lb. per acre and Chilean nitrate at 20 lb. per acre were tried. The Chilean nitrate and ammonium sulphate treatments differed significantly from the control.

An experiment was conducted at Coorg to find out the effect of lime application on paddy with four treatments (1) control, (2) 500 lb. of quick lime per acre at the time of planting, (3) nitrogen at the rate of 40 lb. per acre in the form of groundnut cake, and (4) quick lime and nitrogen at the above rates. The differences of response with these were not significant.

In the experiment to find the effect of manganese application, five treatments were taken up. They were (i) control, (ii) one lb. of manganese sulphate per acre to the puddled field, (iii) 2 lb. of manganese sulphate per acre to the puddled field, (iv) spray of 1 per cent manganese sulphate solution to the crop sprayed 30 days after transplanting, and (v) spray of 2 per cent manganese sulphate solution to the crop after 30 days of transplanting. The differences were not significant.

Kiribiliya, Sannabatha, Mambiliya, Andhrewsail and B.A.M. 3 were grown on the farm for seed purposes. The seeds set apart for this purpose were thoroughly rogued, harvested, thrashed, cleaned and preserved and distributed among the ryots of the State in their pure form.

The response to nitrogen and closer spacing was more pronounced in late planting than in early planting. Application of P.O. alone had practically no effect on the yield but in conjunction with high doses of nitrogen, it appeared to help in reducing lodging.

349 Jhona and 370 Basmati when green manured with Dhairicha gave 651 lb. and 602 lb. more paddy per acre respectively than the control. Under Gurdaspur condition, green manuring appears to be the cheapest source of Nitrogen for paddy.

Paddy stem borer (Schoenobius incertellus)

Activity and the incidence of paddy stem borer in relation to different weather conditions, were observed throughout the period under report. For determining the peak period of the activity of this insect at night in West Bengal, quantitative study was undertaken on the insect, trapped during the night, at intervals of every four hours. The meteorological factors, such as maximum temperature, minimum temperature rainfall, humidity and phase of moon were recorded daily, to observe the relation of these factors with the activity of this insect.

It was observed that the activity of the insect positively correlated with the maximum temperature of the previous night, minimum temperature of the night, and the humidity recorded at the time of putting out the light. It was observed that a large number of insects were caught in the light-trap during the no moon week, whereas during the full-moon week, the number of trapped insects was very small. It was inferred that the activity of the insect decreases after 2 a.m. in the night.

An experiment was conducted, to find out the extent of damage done by the paddy stem borer to different strains of paddy. The data were taken from pure line cultures numbering 223 strains. From the collected data it was found that the percentage of damage varied from nil to 6 per cent. Of the 223 strains, 17 were without any damage, 129 were with 1 per cent., 53 with 2 per cent., 13 with 3 per cent damage, five with 4 per cent, three with 5 per cent and three with 6 per cent damage.

In an experiment to study the proportion of larval production by the different species of paddy stem borers in the borer-damaged-plants, 1,000 paddy plants were dissected and studied. Four hundred and four plants were found containing the larvae of *S. incertellus* and 273 paddy plants the larvae of *S. inferens* and 323 paddy plants the larvae of *Procerus* (*Diatraea*) *venosata*. Roughly, 41 per cent of the damaged plants contained the stages of *S. incertellus*, 27 per cent *S. inferens* and 32 per cent of *Procerus*.

An experiment for insecticidal control was conducted with nine treatments. The treatments were, control, DDT (5 per cent), BHC (5 per cent), DDT (50 per cent wettable dust) and spray with 0.1 per cent concentration, BHC 50 per cent wettable dust and spray with 0.1 per cent concentration, and Toxophene (5 per cent.) dust and spray 0.1 per cent concentration. There damage was appreciably high in the control plots, while in the treated plots the damage was significantly low.

Study on paddy stink bug (Leptocorisa acuta Thun.)

The seasonal incidence and the activity of the insect in response to the main weather factors were recorded throughout the year. The insect being photo-tropic, two light traps were used to catch it at the State Agricultural Farm, Chinsurah, for determining the peak period of the activity.

Estimation of losses done to paddy by Stembor and paddy stink bug

For this experiment, data were taken once only at the time of harvest. Six samples from 3 ft. x 3 ft. area were examined at random in each of the fields. While taking the data, each field was divided into two halves and three samples from each were chosen at random. In each sample, the number of healthy ear-heads as well as the number of white ear-heads due to paddy stemborer, rice bug and other causes were noted separately. Again, the yield of same healthy ear-heads and the yield of the ear-heads damaged by the bug, as well as the yield of the entire field, were noted. The paddy varieties observed were Ashkata, Kelea, Bhutmuri, Bhangi-34, Dharia, Badkalamati-65, Rupsai, Ajan-246, Bhingasail, Nonaramsail, Raghusai, Basmoti, Randhaniaga, Sindurmukhi, Bhasamanik and Nagra-41/14.

Studies on rice hispa (Hispa armigera)

The activity of *Hispa armigera* in relation to the different weather conditions of the day was observed during the period under report. The meteorological data, such as maximum and minimum temperatures, humidity and rainfall, was recorded every day at 6 a.m. and at 1 p.m., to correlate the effect of these factors on the activity of *H. armigera*. From the graphical representation of the daily catch

and the different weather conditions, it was found that there existed a definite relation between the catch and the different meteorological factors. It was further noted that a heavy rainfall immediately dwindles down the activity of *H. armigera*.

Experiments conducted to estimate the damage done by the rice hispa showed that the intensity of damage by adult hispa in the seedling stage was 0.95 per cent., in the transplanted paddy 5.84 per cent., in the flowering stage of the crop 0.61 per cent, and in the rice stage of the crop nil.

In another experiment, which was conducted to note the effect of the application of the different insecticides against the rice hispa, nine treatments were taken up for comparison. The chemicals used were DDT (dust and spray) and BHC (dusted spray), Folidol (dust and spray) and Toxophene (dust and spray). The post-application count revealed that the damage was appreciably high in the control plots whereas in the treated plots it was significantly low.

Source of *Helminthosporium oryzae* C. W.

From Extensive examination of soil samples collected from different depths in the paddy fields at Chinsurah, it was observed that *Helminthosporium oryzae* did not live in the soil. The fungus was found to be present in the stubbles left over in the field after harvest. Artificial soil inoculation experiments indicated, that in inoculated soil, there was no significant difference in mortality of the seedlings over the control, though leaf infection was high. The fungus present in the stubbles was found to withstand summer heat under certain conditions. None of the two varieties, *Aus* or *Aman* was found to be completely resistant to infection in nature; but estimated on a quantitative basis, a great degree of variation in susceptibility was noted. Some of the varieties, particularly fine and earlier ones were less susceptible to attack. Variation in susceptibility was also recorded on the same variety grown in different localities.

Aus paddy when grown under conditions of transplanation exhibited less grain infection. An application of high doses of manure, particularly nitrogenous fertilizers, tended to increase infection. An application of phosphatic fertilizers with nitrogenous fertilizers, appeared to induce resistance particularly in respect of grain infection. Infection was high under conditions of inadequate or poor manuring.

An application of fungicides tended to lower the infection in the initial stages. Under certain conditions, spraying seemed to be more effective, though it was more hazardous, and dusting was found to be easier from the operational point of view.

WHEAT

Trials of varieties and progenies to rust resistance

Work on rust resistance of seedlings and adult plants of fixed varieties was continued at Poona. Five N. P. wheats were tested for seedling and adult resistance. N. P. 792, 797 and 799 were found to be immune to eight races, intermediately susceptible to race 42B and susceptible to the races 15C and 122 and immune to moderately

resistant, to eight more races in the seedling stage. The infection on these N. P. wheats in the field was not heavy since it appeared late. Tremez Rizo, a *durum* wheat from Australia, which was resistant in the field test last year, proved susceptible, when tested this year. It was susceptible in the seedling stage. Of the six Mexican wheats mentioned in the previous year's report, No. 80 (original No. 523C) was the best of all from the point of resistance to the Indian races of stem rust. It was immune or highly resistant to 11 races, including all the commonly occurring ones, at low as well as at high temperatures and only some what susceptible to race 122, which was a rare one. No. 83 (original No. 5653C) was immune or highly resistant to all commonly occurring races and intermediately susceptible to races 15C and 122.

At Poona, Kenphad wheats were found to be immune or highly resistant to races 15, 21, 24, 40, 42, 42B, 53 (117) and 184 at low temperature but the resistance broke with rising air temperature. Kenphad wheats 21, 25, 28 and 32, when grown on the plains at the Sugarcane Research station, Padegaon (District Poona), under artificial epidemic of rust developed more infection than that observed at Mahabaleshwar although it was much less than on the parent variety (Niphad-4).

The results of the seedling resistance tests of 15 fixed hybrids mentioned in last year's report were confirmed in this year's tests. Hybrids 3, 5, 8, 11, 12, 14, 18, 19, 25 and 38 were susceptible to race 42B, more so at high than at low temperature in Madhya Pradesh. None of them was as susceptible as the controls, *viz.*, A115 and A013 when tested in the field. About 5,500 plants of nineteen crosses in F2 and the progeny of 874 individual of bulk selections of other generations from F3, to F12 were tested in the field.

Seventy-five wheat varieties were tested for seedling and adult resistance in Hyderabad. None was highly resistant to all commonly occurring races of stem rust. H-2-1 and H-5-3, though susceptible in the seedling stage to race 21 was not heavily infected. Two more varieties (1386 and 1387) were highly or moderately resistant to eight races in the seedling stage and like cabo was semi-resistant in the mature plant stage.

Districts trials conducted under the Niphad Scheme revealed that :

(1) Jay and Niphad-4 were outstanding and Kenphad-34 and 39 were doing well at Darwar.

(2) At Bijpur, Jay and Local were outstanding. NHd-71 and KCN selection were doing well and were better than Kenphad selections.

(3) NHd-39, NHd-66 were outstanding while Kenphad-34 was promising at Bailhongal.

K.25, NHd-177, 345, 204, 284 and 152 were promising under irrigation at Kopergaon. At Dhulia, NHd-152, 254 and 177 were promising under irrigation. Gulab was outstanding at Jalgaon, but NHd-39, NHd-66-71 and KEN-179 were doing well under rainfed conditions.

NHd 177 and 345 were outstanding at East Khandesh under irrigated conditions. Kenphad 32, NHd-71 were outstanding under rainfed conditions at the same place. NHd-345, 177, K-21 were outstanding under irrigation and K-32 was promising under rainfed condition at West Khandesh. At Nasik, NHd-345 was outstanding under irrigation, Kenphad-28 and NHd-71 were promising as compared to local under rainfed condition at Nasik. NHd-177, KEn-133 and Niphad-4 were outstanding as compared to local while KEN-132 was outstanding under irrigation at Amreli, Gujrat. At Baroda, NHd-345 and N. P. 715 were promising under irrigation. At Banastantha N. P. 715 was outstanding and then next in order was NHd-177, 345 and N. P. 710 was superior to local under irrigation. At Sabarkhanta, N. P.-710 was outstanding, while NHd-177, N. P. 715 were competing at Bijapur. In Karnatak, NHd-177 and N. P. 710 were quite outstanding as compared to N-4 under irrigation. At Dharwar N. P. 715 was outstanding while NHd-177 was on par with local under irrigation.

In the trial conducted with 26 imported rust resistance strains against the local variety and the improved varieties of Hyderabad State (Badnapur) viz. PW-1, PW-3 and PW-5, it was found that the latter gave higher yields than the imported ones. These crops were raised dry and there was no attack of rust on them. Though the attack of rust in the local variety was 20-25 per cent., yet it gave a higher yield than that of all the imported varieties.

Twelve winter wheat varieties from Austria were tried under irrigation at Niphad for rust resistance. None of them were found to be suitable for direct use or hybridization since they were very late varieties. They did not flower at all even after growing for 5½ months. N. P. 809 was tried under rainfed and irrigated conditions. It was a very late variety and yielded very low outturn. Under irrigated conditions, though the yield was fairly good, it was found to have undesirable grain qualities. S. N. P. types were studied on randomized blocks. N. P. 758, Mondhya-3-2 and Kenphad-25 were significantly better than others but the quality of grain of N. P. 758 was not good. It was observed that N. P. types were susceptible to most of the races and moderately susceptible to race 42B which was of frequent occurrence in the State.

In all, 454 collections (442 from wheat, nine from barley and three from wild grasses) were analysed at the Indian Agricultural Research Institute, New Delhi. These were from crops of 1953-54 and 1954-55. The races 15, 21, 24, 34, 40, 42, and 122 of black rust; races 10, 11, 20, 26, 63, 77, 106, 107 and 108 of brown rust, and races 13, 19, 20, 31, A, D, F and G of yellow rust were met with. The new race 77 of brown rust picked up from Bihar was very virulent as it attacked the varieties Mediterranean and Democrat which were resistant to all the previously known Indian races. The race 122, known to be the most virulent, was found in two collections, one from Delhi and the other from Kulu valley. Besides wheat, the race 13 of yellow rust was met with in naturally infected samples of perennial grass, *Muhlenbergia hugelli* Trin. from higher altitudes of the Simla hills. The race G of this rust was met with on barley alone.

Only two collections gave interesting results in regard to collateral hosts. The rust from *Muhlenbergia hugelli* grass collected during winter months from Fagu. (8,200 ft.) in Simla hills could successfully infect wheat and barley and yielded race 13 of *P. glumarum*. The grass raised from seeds was found to be susceptible to race 13 and also to a mixture of all the races of yellow rust. This indicated the possibility of over-summering of yellow rust on this perennial grass.

Forty-nine wheat varieties and crosses were tested with the individual races of black rust in the seedling stage. The varieties E. 871, E. 1913, E. 1951 and E. 2025 were found to be susceptible to all the races. In all, 57 wheat varieties and crosses were tested against mixture of races and biotypes of black rust. The varieties E. 1906, E. 2564, WR. 216 and W. 375 and S. 77 were found to be resistant. Forty wheat varieties and crosses were tested with individual races of brown rust and the varieties E. 1065, E. 1170, E. 1847, E. 1882, E. 1912, E. 2143, E. 2144, E. 2285, E. 2446, E. 2547, E. 2548, E. 2562, WR 160 and WR. 187 were found to be resistant. Rajasthan Nos. 1, 17, 18, 20, 25, and 26 also showed resistance. Thirty-five wheat varieties and crosses were tested with individual races of yellow rust and varieties N. P. 785, N. P. 786, N. P. 814, HD. (52)-30 and E. 1844 were found to be resistant. Eighty-nine wheat and nine barley varieties and crosses were tested with a mixture of different yellow-rust-races and the following wheat varieties were found to be resistant: E. 1770, E. 1771, E. 1851, E. 1878, E. 2067, E. 2546, Hyb. 46, Wr. 160.

At Simla (I.A.R.I.), 839 plants were tested with the three rusts individually or in mixture in adult stages and the promising cultures from important crosses were selected. At Delhi, in the adult stage approximately 70,000 plants were tested with the three rusts.

About 277 varieties both indigenous and exotic were tested for their rust reaction under artificial epiphytotics to a mixture of all the 10 races of two biotypes of black rust at Indore (I.A.R.I.). These included 196 indigenous ones and 81 exotics. Only six provincial types and 6 N. P. wheats showed resistance. Quite a large number of exotics and W. 292 and W. 375 selections showed resistance or semi-resistance to black rust. A large number of progenies of intra- and inter-specific crosses in different generations were tested for their reaction by subjecting them to artificial infection of a mixture of 12 races of black rust. These were closely studied for their agronomic characters at Indore. It was found that nearly all the F₁ of the primary crosses were susceptible to the mixture of races. Many of them were very promising agronomically.

In yield trials also, 11 *vulgare* and 9 *durum* varieties were tried both under barani and irrigated conditions. Under irrigated conditions, Alapur 6-1 (*vulgare*) topped in yield and was followed by Niphad-4, N. P. 710, B. 14 and N. P. 718. Under barani conditions Motia (*durum*) out-yielded and Alapur 6-1 was second to it. Eleven black-rust resistant varieties of N.P. 700 series were compared with four controls. The highest yielder was N. P. 788 followed by

N. P. 798, N. P. 799, Niphad-4 and N. P. 797. Sixty-eight types involving 20 vulgares and 48 durums were compared with four controls (three of vulgare and one of durum). Ujjain progeny 12 outyielded the rest. The first five were all vulgares. Among the durum types, G. D. 11 was the highest yielder.

Seeds of 18 exotic varieties, viz., E. 2526 to E. 2543 were received for the first time during the year and were multiplied for observation and description of their morphological and economic characters at Simla (I.A.R.I.). Twenty-eight exotic varieties tested during 1952-53 were selected for replicated preliminary tests as they compared favourably with both of them as regards yield, rust resistance and grain quality. Besides the material in the preliminary tests, 24 exotic varieties were tested in a replicated test. E. 794 (Natopo), E. 896 (Steindwel X T. *timophesbi*) and E. 746 (A Kenya wheat) significantly outyielded both N. P. 770 and Ridley, included as controls in this test. It was encouraging to find that some of these varieties possessed a good quality of grain besides a high degree of rust resistance. In the exotic and Indian trial varieties, Ridley and Padova II significantly outyielded all the other tested varieties. E. 964 (Impeto), E. 1045 (Kenya 360-11) and E. 962 (Funao) compared well with N.P. 770 and merited testing again in the following season.

Fifteen exotic varieties were tested for resistance to individual races of brown rust and the following reactions were observed :—

- (1) E. 928, E. 931, E. 952, E. 1951, E. 2025 and E. 2158 varieties were resistant to all races.
- (2) E. 569, E. 871, E. 938, E. 997, E. 1906 and E. 2083 varieties were resistant to all but one race.
- (3) E. 144 and E. 1879 varieties were resistant to all but two races.
- (4) E. 616 variety was resistant to all but three races.

Of the 36 exotic varieties tested against a mixture of Indian races of brown rust, E. 1044, E. 1809, E. 1818, E. 1823, E. 1844, E. 1849, E. 1867a, E. 1944, E. 2140, E. 2224, E. 2259 and E. 2295 were found to be resistant. Fifteen exotic varieties were tested against all the individual races of yellow rust and five varieties, viz., E. 630, E. 687, E. 740, E. 928 and E. 952 were found resistant to all of them. E. 671 was resistant to all races but one. Of the 34 exotic varieties tested against the mixture of all the races of yellow rust, only three varieties, viz., E. 1844, E. 1928, E. 2259, were found resistant. It was observed that E. 928, E. 938, E. 952, E. 1844 and E. 2295 were seen resistant both to the yellow and brown rust races.

At the I.A.R.I. the material included for testing comprised of 456 exotics and 115 improved indigenous wheats. A mixture of all the physiological races of the three rusts occurring in India were used for inoculation.

A large scale yield trial comprising of 14 varieties including the control were laid out in randomised blocks in six replications at nine centres. These trials confirmed the suitability of the varieties N. P. 799, N. P. 761, N. P. 755 and N. P. 758 for large scale cultivation in Bihar. Another variety added to the trial this year (N. P.

782) also appeared to be promising. The variety N. P. 799 exhibited a very high degree of resistance to black rust. Small-scale trials were conducted with 11 exotic varieties and five N. P. wheats with three replications. The exotic E. 871 appeared to be promising because of its early maturity, freedom from rust and fair yield. E. 952 which was free from all the three rusts was very late and was red grained. The average highest yield was recorded by E. 569.

Ten rust resistant strains namely W. 7/23, S. 7/25, W. 10/67, W. 10/69, W. 206/88, W. 245/33-8-7-5, W. 245-33-8-7-16, W. 245/125, W. 245/134, W. 246/157 from I.A.R.I., New Delhi, and ten rust resistant strains namely Hy. 3, Hy. 5, Hy. 11, Hy. 12, Hy. 25, Hy. 38, Hy. 65, Hy. 172, Hy. 277, Hy. 278 and one improved strain A, 115 from Powerkheda were received at Durgapur (Rajasthan). These were tried against locals G. 591 and R. S. 31-1 at Durgapur. Infection by all the three rusts was very little in all the varieties. Local gave significantly higher yield than all the other varieties. Varieties Hy. 11, Hy. 277, Hy. 38, Hy. 65 and Hy. 12 gave significantly higher yields over all I.A.R.I. strains. Ten exotics were tried against local, and R. S. 31-1. The latter gave the highest yield. All the exotics were either free from rust infection or the infection was very little.

Breeding work

Inter-varietal crosses consisting of a number of varieties and progenies were grown and studied in detail in Madhya Pradesh. Most of the crosses in F₁ generation and some of the rust resistant hybrids were under distribution. A large population of F₂ was grown at Mahableshwar and a few progenies at Powerkheda. Progenies with good stooling habit and compact ear and bold grain were obtained from crosses of Hy. 277 × A 115 and C.P.V. 30-4-2 × E. 220 in F₃ generation and from crosses, Gabo × Hy. 65 × P.C. 36 in F₄. The cross N. P. 758 × Hy. 172 in F₄ was impressive in growth at Powerkheda and Mahableshwar. From the double cross between hybrids 65 and 278 and its reciprocal, good tillering culture and homozygous for the purple auricle character (which is of a great diagnostic value) were obtained in F₆ generation. They were also found to breed true for rust resistance. Among the durum crosses, early to medium ripening cultures were selected from crosses between Gaza, Ao. 98 Haura, E. B. 58 and Indore 69. At Pipri village near Wardha, some of the durum cultures selected last year from F generations of these crosses were grown both under dry and irrigated conditions along with susceptible parental strains. In the irrigated areas there was a severe infection of stem rust. Two cultures of the cross, Gaza × Ao 98, showed in F₆ only a trace of infection and under dry conditions were also vigorous in growth and early in maturity. Twenty-four cultures of vulgare crosses in F₁ to F₆ generations gave as good an outturn as A 115 and Hy. 11.

Breeding rust resistant strain for double cropping was taken up at the Experimental Farm, Waraseoni (Balaghat). Sixteen early ripening N. P. strains and 14 homozygous cultures of crosses N. P. 114-3-2 × Kendee 11 and N. P. 114-3-2 × Kendee in F₆ were grown in five to seven rows 10 ft. long. Ten cultures and some N. P. strains (N. Ps. 805, 100, 125, 177, 165; and PC. 36) appeared to be superior in

yield to the rest. One thousand and eighty-two rust resistant synthetic material of different crosses mostly from Gaza in various generations (F₁ to F₇) were tried on rod rows under irrigation with Vijay, Niphad-4 and Boxi-288-18 as checks at Niphad. In all, 464 selections were found to be promising for yield and other agronomic characters. Out of 48 promising derivatives of Gaza × Vijay and Gaza × Baxi types in F₆ to F₇ generation, tried for yield and other agronomic characters on small plots with Jay and Vijay as checks under rainfed conditions at Niphad, 25 cultures were found to be promising. These cultures combine high yield and rust resistance. Similarly among the nine cultures tried under irrigation, three cultures were found to be promising, both for yield and rust resistance. Out of 69 promising, rust resistant cultures (45 dry and 24 irrigated) tried under drilled condition in large plots, 27 cultures (16 dry and 11 irrigated) were found to be promising since they combined high yield and rust resistance qualities.

As a result of hybridisation between the best indigenous types and exotic varieties known to be rust resistant at New Delhi (I.A.R.I.), some rust resistant varieties were evolved. The rust resistant varieties evolved in such crosses were E. 572 (Ridley), E. 581 (Kenya) 84 P. 2. AIF, E. 931 (Gaza) and N. P. 790 for black rust, E. 957 (Frontiera) and E. 928 (La Provision) for brown rust, and E. 671 (Cometa Klein) for yellow rust. The commercial varieties were N. P. 710, N. P. 718 and C. 591.

Sixty-three crosses of different types were successfully attempted with a view to combine best agronomic characters of indigenous varieties with rust resistance and also some desirable grain characters of exotic types at Indore (I.A.R.I.). These 63 crosses included 21 primary crosses, of which nine were interspecific between *T. durum* and *T. vulgare* and 12 interspecific were either of durum or of vulgare as one parent. Out of the rest there were 21 first back crosses, 5 second back crosses, 2 third back crosses, 12 three way crosses and two double crosses.

An attempt was made with the crosses and fixed hybrids of the advanced generations to combine simultaneously resistance to more than one rust at Simla (I.A.R.I.). Twenty-three fixed hybrids of the crosses W. 292, 24 of W. 311, 6 of W. 312 and 2 of W. 329 were tried in replicated plots with Ridley and N. P. 770 as controls. All of them were free from rust infection and some of them, viz., Hs. 311-54-29, Hs. 311-53-12, possessed attractive hard grains. Ridley yielded the highest, though there were no significant differences among the first eight varieties. In cross W. 375, an attempt has been made for combining the black rust resistance of the Kenya Vulgare (E. 220), the brown rust resistance of an American wheat (Democrat), and the yellow rust resistance from another American wheat (Spading's prolific) with the desirable characters of the Indian wheats, N. P. 114 and Pb. C. 518. The hybrids derived from this cross combined a high degree of rust resistance and large number of these were available for tests at different levels in the breeding programme. Seventy-eight strains derived from this cross were laid out in two replicated row tests with N. P. 770 and Ridley as controls. In test No. 1 Ridley topped the list though no significant differences were observed among the first 13 varieties including N. P. 770.

The fungus strains used in the coupled hybridization programme followed for the purpose of studying rust resistance, were seen to transmit some of their undesirable characters of poor grain quality. From 192 cross two virus strains derived from the cross W 715, one possessing a very high degree of rust resistance and the other excelling in grain quality, were crossed in order to improve the grain quality. Some eight progeny resulting from this cross were seen to be completely free of any rust infection and produced good quality of grain.

Most of the hill wheat varieties bred at Shimla (I.A.H.I.) and entered in the cooperative regional testing programme in the states of the Punjab, Himachal Pradesh, Uttar Pradesh and West Bengal were included in a test conducted at the Breeding Farm, Shimla. It was seen that Kelsey significantly outyielded the rest of the varieties tested. It was followed by N. P. 124 which was significantly better than the remaining varieties. N. P. 121, N. P. 211, Simla local, N. P. 206, N. P. 122, He 213-1235 and N. P. 123 came next and there were no significant differences among these.

The exotic varieties that had done well during the preceding years were tested twice during the year under report. R. 711 (Favor), R. 214 (Gato cross), and Kelsey occupied the first position and the differences in yield among the varieties including N. P. 124 were not significant. R. 214 (Gato x Kelsey) was free from rust infection.

Foot rot disease of wheats

Survey of wheat crops at Poonchhara, Bagar, Jaisalpur, Nanawapuri, Bawal, Chindwara, Daulat and Kapur were made to observe the incidence of this disease in Madhya Pradesh. The causal organisms in each case were isolated. The data in respect of sowing period, methods of cultivation, soil characters, environmental conditions at sowing time and cultural practices were collected. Isolations to find out the predominant causal organisms were made from diseased plants collected from different localities. The examination of isolations revealed the presence of *Fusarium* sp., *Helminthosporium* sp., *Curvularia* sp. and *Sclerotium rofei* single or in combinations of two organisms. The single spore or mycelial isolates of *Fusarium* sp., *Helminthosporium* sp., *Sclerotium rofei* and *Curvularia* sp. were obtained and the pathogenic trial would be taken up during the next season.

BARLEY

Last year's varietal trial was repeated in Rajasthan with the modification that five Simla varieties, viz. Po. T. 4, B. 12, B. 224, B. 65 and B. 161 were also included in the trial. The variety R. S. 17-3 gave significantly high yield over K. T. 12, R. S. 10, N. P. 13, B. 245, B. 2224, B. 65 and B. 161. The following main results were obtained:

The variety C. 50 had significantly more stand in comparison to local. This variety was also more resistant to smut when compared to N. P. 121, K. 12 and C. 251. Rajasthan selections except C. 50 were comparatively more resistant. Varieties C. 50, N. P. 13 and K. 12

had more height in comparison to R. S. 17. N. P. 13, had a larger number of tillers as compared to K. 12. The variety N. P. 13 and N. P. 21 took greater number of days for ear-initiation in comparison to other varieties. C. 50 took less number of days for ear-initiation in comparison to all other varieties. N. P. 13 matured significantly late in comparison to rest of the varieties followed by N. P. 21, R. S. 30 and G. 251, took more time in comparison to Rs. S. 17, R. S. 30, and N. P. 21 and had greater number of ear bearing tillers in comparison to K. 12 and N. P. 13. The varieties C. 50, R. S. 30 and K. 12 had significantly a higher yield over C. 251, and local. R. S. 17, R. S. 30 and K. 12 had significantly higher yields than C. 251, N. P. 21 and N. P. 13. N. P. 13 had less grain weight in comparison to all the other varieties.

Manurial trial. Three different doses of nitrogen, viz., 20 lb., 40 lb., and 60 lb., singly and in combinations with a fixed dose of P_2O_5 and a control were tried in Rajasthan. Thus, in all, there were seven treatments viz., N1, N2, N3, N1, P1, NP and control, N3P1 took significantly a greater number of days over N₁ and control. Plants under N₁ gave significantly a higher yield over N₂P₁.

MILLETS

Bajra (Pennisetum typhoides)

Five hundred and ten inbred lines were raised and studied in different generations of selfing at Madras. Selections from desirable lines were taken for further study and 402 lines were advanced. Many of the lines were top-crossed to adopted varieties for judging their general combining ability. Of the inbreds under study, 108 were top crossed to suitable testers. Forty-six new single crosses between short-duration inbred and 16 double crosses between superior single crosses were also effected during the period. The top-crosses were compared in replicated rows for yield in different groups according to their origin. The lines in S. 7 and S. 8 generations were compared with their parents and tester. Among the 65 single crosses tested, 11 of short duration and 12 of medium duration varieties proved significantly superior to the standard.

A total quantity of 37, 776 lb. of seeds of the hybrids, parents and strains were distributed for large-scale cultivation. Nine thousand eight hundred and seventy pounds of the seeds of parents were issued to seed farms and 18,425 lb. of seeds were procured.

Jowar (Sorghum sp.)

One hundred and forty-six promising cultures obtained from nineteen biotype from Bombay, Madhya Pradesh, Madras, eleven from Saurashtra and 28 from Jamnagar Giant Bajra were tested for yield, period of maturity, size and colour of grain and other requisite characters along with the local *bajra* as control. Out of 146 cultures, only 46 showed increase in yield over that of local by 25 per cent, and more. Of these 46 cultures, only 13 cultures owed their origin to *bajra* biotypes brought from other states in India and 33 cultures have been derived from the *bajra* material collected from within Saurashtra. On the basis of the period of maturity, the high yielding 46 cultures resolved into three distinct groups. It is impor-

tant to note here that, unlike the case of *bajra*, not a single culture derived from *jowar* varieties collected from areas outside Saurashtra responded well under Saurashtra conditions. Only the home material proved to be the best source for isolating high yielding types with requisite characteristics. Eight early cultures of *jowar*, which had consistently given better yield performance during the past three seasons, were put to large-scale yield trials with C-10-2 and Jamnagar Jowar as control. It was obvious from the yield and maturity data that five out of the eight cultures were distinctly superior to C-10-2 and Jamnagar local in yield earliness and colour of grain.

At the Agricultural Research Station, Mandyal, 72 selections collected from cultivators' fields were tested for their *Striga*-resistance with standard N. 1 and A. S. 4003 as controls. Twenty-five selections showing a low percentage of *Striga*-infection were selected for further study. At the Agricultural Research Station, Lam, 73 derivatives from crosses of N. 1, T. 6 and G. 2 with A. S. 4003 were tested in row trials of which 41 were carried forward for further study. The hand-weeding and spraying experiment was in the fourth year of trial at Mandyal and third year at Lam. The percentage of *Striga*-infection was studied. The chemicals (Fernoxone and Agroxone) were sprayed once in their respective doses. The data on percentage of infection, grain and straw yields were analysed; the differences were not significant at both the centres.

MAIZE

Breeding

Rigorous selection of the inbred lines obtained from the selfed material of the previous year was made at both the stations, Kandaghat and Rauni, Patiala (P. E. P. S. U.).

To study the effect of successive selfing on homozygosity, detailed observations of all the inbred lines were recorded. The extent of homozygosity was that characters like tasseling period, length of cob and circumference of cob reached homozygosity earlier than the height of the plant, 100 kernel weight and yield per cob.

Seventy-four inbred lines belonging to various selfing generations were imported into P. E. P. S. U. from I.A.R.I., New Delhi, and Hyderabad. Out of the 22 single crosses tried two single crosses gave a higher yield than the local. Ninety-one single crosses were attempted out of which 47 were selected for trial during the coming *kharif*. One double cross of a set of 32 double crosses tried outyielded the open pollinated croup. Out of the 12 imported hybrids from the Punjab five crosses outyielded the locals.

Six open pollinated varieties, *viz.*, Kalimpong, Jaunpur, Tinpakhia, Piarka and Annaur, were maintained by hand crossing during the *kharif* of 1954. In summer the following varieties were added to the list of collections and grown for maintenance: Gokak, Sumari, Dudhnagar, Rajasthan — 1(r-1), R-2, R-3, R-13, R-17 and R-21.

Fifty-one inbreds which were selfed for various generations, were selected and grown in the *kharif* of 1954. The germination was good but the crop failed due to continuous heavy rains. Thirty-five top crosses along with one check variety were grown with four replications at Sabour. The crop failed due to continuous rains.

At Pusa, earthing up of maize rows had no significant effect on the yield of cobs when compared to those plots which were not earthened; rather it significantly lowered the yield at Monghyr. Spacing trial with row system of planting, yield trial with the best pollinated varieties, the effect of topping on the yield of maize, the effect of yield due to different manures applied in various combinations, yield and observational trials with the foreign introductions and the generical studies with the off-types were some more agronomical experiments conducted in Bihar, 1955. During the *rabi*, 268 lines were studied and one hundred lines were found promising.

During the *rabi* season, 159 top crosses, 22 single crosses and 14 double crosses were made at Hyderabad. Thirty top crosses were tested but the results were not significant. Top crosses with No. 694 (U.S.A.), 394 (Punjab) and 800 (U.S.A.) inbreds occupied the first three places respectively. During the *rabi* season 12 crosses, mainly of inbreds 376, 377 and 383 and 698, were found to be superior to HM1. Six U.S.A. hybrids and two Indian varieties were tested and the results were found to be significant. Five hybrids gave yields superior to the controls. Seventy samples of South and Central American maize varieties were sown in two row sets with HM1 and Kt41 as controls. The hybrids, Dixie 18 and NC 27 and single cross A 14 proved to be promising at Hyderabad.

The test with nitrogen phosphates and potash was repeated during both the *kharif* and *rabi* seasons. In both the seasons significant increases in yields were observed on account of applications of phosphate and potash. The various interactions between them were not significant.

The stem borer on maize was found during both the seasons and DDT was satisfactorily sprayed to check the spread of the pest at Hyderabad. Slight attack of leaf blight was also noticed.

At Himayatsagar, seventy samples of maize consisting of open pollinated varieties single and double crosses collected from South American countries and Mexico and KT 1 KT 41 were tested. Thirty-one of the varieties were superior to HM1 and 47 to KT41. Forty-seven open pollinated varieties of Hyderabad were found superior to HM1. Selfing was carried out to build up inbreds. During the *Kharif* season, 2502 cobs were selfed and seed-setting was successful in 2,220 cobs. A total of 77 inbreds from Bombay, U.P., the Punjab, Egypt and U.S.A. were grown for use in top crosses and single crosses. A total of 47 top crosses were obtained by crossing vigorous and promising S. 5 lines with HM1. Stocks numbering 28 in all of genetic and economic value were selfed and carried forward.

During the period, 43 Indian and 24 exotic varieties were maintained from the old collection. Moreover, 29 new Indian collections and 70 new varieties from central and South America were multiplied at the I.A.R.I. Trials with open pollinated varieties were taken up. In the first trial 20 Indian varieties were studied for the first time Texas 26, a U.S.A. maize hybrid, used as a check, gave the highest yield followed by Piarka local, a variety from Bihar. The above mentioned varieties matured at the same time as K. T. 41. In the second trial also the check Texas 26 topped the list. Only this variety outyielded K.T. 41. The trials with the seeds received through the

Rockefeller Foundation Expert Team, showed the following to be best adapted among the seeded varieties; G788W, Durango, V-520C, Rocamex H-503, Antigua Moreles, Carmen and Papalaopan. Among the yellow seeded types the following seemed to be best adapted: G-733, G-715 Cornelli 31, H. M. D. 4624. However these varieties were generally late maturing.

The extent of homozygosity required in the inbred lines consistent with high yields in crosses was taken up for determination. Different methods of determining combining ability of inbred lines were also studied.

In a trial under intensive cultivation, where the plot size was $\frac{1}{2}$ acre, N C. 27, gave an yield of 56 maunds, 16 seers per acre, while K. T. 41 gave 46 maunds 15 seers per acre (I.A.R.I., 1955).

The male sterile experimental material obtained from the U.S. was maintained during *Kharif* 1954. The stock was indicated to segregate to one male sterile (ms) and one male fertile (Ms). This was crossed with the fertile pollen of the inbred line. Meanwhile more male sterile material has been obtained (I.A.R.I.).

Work on the induction of polyploidy was carried out by the Cytogeneticist at the I.A.R.I. Maize seeds were germinated in an agar-colchicine jelly comprising of equal parts of 2 per cent. agar and 0.25 per cent colchicine. The treated plants had coarser and darker green leaves in comparison to the control. The stomatal size in the treated plants was 51 and in the control 21. The tetraploid nature of the treated plants would be confirmed after the chromosome counts are made later.

A large scale trial with five American hybrids, viz., N. C. 27, Texas 26, Funk's hybrids, Dixie 18 P(T)2 and three improved strains K. T. 41, Bassi Selected and Udaipur Selected was conducted at Udaipur. N. C. 27 gave the highest yield followed by Udaipur Selected.

Fourteen top crosses were tested against 14 important double hybrids, provincial strains and improved strains of Rajasthan. N. C. 27 outyielded other strains giving 4089.56 lb. per acre yield followed by the top cross. 620(51)-3, P(Y)2 gave the lowest yield. Nineteen top crosses and nine other varieties were tried. Texas 26 gave a significantly higher yield over all top crosses and varieties except Udaipur Selected.

In the third trial 30 varieties were tried. The varieties Jaunpur white and Udaipur Selected gave significantly higher yields over all varieties except Jaunpur yellow. Twenty-four single crosses were tried against improved strains and three American double hybrids. The various differences were found to be significant at 5 per cent. level. Alwar gave the highest yield, i.e., 3569.8 lb. per acre.

Twenty-eight varieties consisting of provincial collections. Rajasthan collections and some new strains of I.A.R.I. were also tried in Rajasthan. The varietal differences were significant at 1 per cent level. The American double hybrid N. C. 27 and Udaipur

Selected gave significantly higher yields over all varieties except Coimbatore Local Kanpur type 40(red), Texas 26, Punchemohar Bombay and K. T. 41.

Introduction of exotic material to enrich genetic stock

Seventy-six samples including varieties from Southern U. S. A., Cuba, Mexico, Central America, Columbia and Brazil supplied by the Rockefeller Foundation, U.S.A., through the Head of the Division of Botany, I.A.R.I., New Delhi were grown at Kalianpur, Baharaich and Almora along with U. P. type 41 and local as checks. At Kalianpur all the varieties, except one (Zapalote chico) were found to mature later than T41 and local. A 35 and B 16, though later than T 41 by 16 days and 9 days respectively, appeared promising in vigour and yield. The most promising of these would be utilised as foundation material for raising inbred lines. (Uttar Pradesh). At Baharaich none of the imported varieties proved to be superior to K. T. 41. At Tarikhet, however, San Andres Tuxtla from Mexico, gave the highest yield and also matured almost simultaneously with Almora local and K. T. 41.

A detailed study of the entire collection revealed that the early cultures in general gave plants lower in height, with cobs borne lower, lesser number of leaves per plant, smaller cobs and smaller size of grains. The late maturing cultures were more vigorous, had greater plant height, bore cobs at higher level, possessed greater number of leaves per plant and bigger cobs with bolder seeds.

Five hundred and eighty seven selfed cobs were obtained from six hundred and seventy three vigorous healthy plants, which were selfed for raising the first generation of selfed lines. Four hundred and ten S1 cobs were retained for further inbreeding and 86 cobs were rejected.

The first set of 25 top crosses (25 of the promising S4 lines which were top crossed with T.41 during *kharif*, 1953) were tested at Kalianpur for evaluating the general combining ability of the lines.

Fifty-four of the S4 promising lines were top crossed and they appeared to be vigorous and early and may possess good combining ability. They would be tested during the ensuing *kharif*.

In the trial with five U.S. hybrids and Pusa Yellow 2, and U.P. types in large-scale trials at Kalianpur, the yield differences were found to be significant. All the imported hybrids as well as Pusa Yellow 2 yielded significantly lower than the U.P. types. Meerut Yellow, a medium early U.P. type, yielded the highest. At Almora also the yield differences were highly significant. A late, dent seeded imported hybrid Dixie 18, yielded highest followed by Texas, 26, another late dent seeded hybrid, and T. 41. All the 18 types of maize sent by Shri B. Sen were out-yielded by the U.P. types.

Germination of sweet corn hybrids was somewhat lower than the local flint. Some inbreds as a result of gradual adaptation gave over 73 per cent germination in the Punjab. All the sweet corn hybrids were earlier in maturity than a local flint, most of them

falling in the categories of early and mid-season varieties. Even the four hybrids, which took a little over 60 days to tassel, were 3-5 days earlier than the local flint. These four hybrids namely P-39 $\times$ P51, P51 $\times$ P30, Stoweels Evergreen and Burpees Evergreen seem to be best suited to Kulu conditions.

After selfing 263 plants belonging to 73 progenies from the previous year, 56 progenies are being carried forward. Five inbreds originally imported from the U.S.A. and Australia, continued to be maintained by Sibbing.

All possible cross combinations were made between five inbred lines from the U.S.A. and Australia *inter se*. Some crosses were also made between them and some inbred lines developed from local material. Out of these, 35 crosses were finally selected for testing in the coming season. With the view to determine the cultural and manurial requirements of sweet corn, the sowing date-cum-spacing experiment and manurial experiments were also conducted.

Hybrid Maize

Plants of 88 inbred lines imported from the U.S.A. were multiplied. One to two cobs of suitable plants of each line were selfed.

Sixty-six single cross parents of late or early double cross hybrid were produced. From the single cross parents of the year 1953-54 twelve very promising double cross U. S. hybrids were produced these were under trial in 1955-56.

S3 seeds of 19 and S2 seeds of three first cycle lines were produced after selection from 54 healthy cobs. The resistance to lodging and leaf blight were kept in view in making selections. Important botanical and agronomical characters have been noted. Suitable plants of four open pollinated varieties from India including one early variety and two open pollinated strains from the U.S.A. of which one was an early variety were selfed for further selection.

Some of the V.L. strains produced in the year 1954-55 were tried in 1955. Most of them have given significantly higher yields than the U.P. open pollinated selection T. 41.

Nine double cross U.S. hybrids and 12 V.L. hybrids and two open pollinated varieties were tried in U.P. It was found that two double cross U.S. hybrids and 12 V.L. hybrids gave significantly higher yield at 5 per cent level than T. 41. The highest yielder, U.S. 13, gave a per plant yield of 4.48 oz. against 4.08 oz. per plant of T. 41.

The varietal trials at the Line Estate, Hawalbagh, were conducted with 9 double cross U.S. hybrids, 14 hybrids of V.L., and 3 open pollinated varieties. Eleven V.L. strains, eight double cross hybrids and one open pollinated variety gave higher yields than T. 41. Eight U.S. Hybrids, all V.L. strains and one open pollinated variety were significantly earlier than T. 41.

From the trials at Almora and Line Estate it was seen that out of the 16 strains, seven hybrids gave significantly higher yields than T. 41 at both the places. The yield of some of the early strains was more than T. 41 at Line Estate only. This seems to be due to

their short life cycle. The results of the trial of seeds sent to the I.A.R.I. New Delhi, indicated that the yields of the U.S. hybrids were 39 to 8 per cent and those of the V. L. strains 31 to 53 per cent. T. 41. N. C. 27 was the highest yielder. The highest yielder among the V.L. strains had a maturity period similar to that of T. 41.

PULSES

Gram (Cicer arietenum)

In West Bengal T 98 came out as the highest yielder with an average yield of 32 maunds and 30 seers per acre. At Ferozepore (Punjab) investigations on gram consisted of finding out the (1) effects of date of sowing using different varieties of gram, (2) effects of time of irrigation on the incidence of the gram wilt disease and the yield of grain, (3) effects of the practice of mixed cropping on the incidence of the wilt disease in gram crop and the yield of the constituent crops, (4) amelioration of heavy soil by the addition of sand and its effect on the incidence of the disease and the yield of grain, (5) the residual effect of sub-soiling done up to the depth of one foot with a tractor plough on the incidence of the wilt disease and the yield of grain from the second successive crop, and (6) the duration of the period for which effect of sub-soiling persists. The results show that mid-October or the end of October is the best date for sowing. The brown-seeded variety, G. 24, has consistently given better yield and has shown greater tolerance to the wilt disease. Best results are obtained when the gram crop is sown unmixed, or where mixed-croppings are unavoidable, sowing the gram crop in rows alternating with those of other crops. It was observed that the addition of sand to heavy soil reduced the incidence of wilt and increased the yield of grain to a great extent. The improvement effected by the addition of sand is permanent. The results obtained indicated that the incidence of disease, though relatively low owing to conditions favourable for the gram crop was reduced from 1.45 to only 0.23 per cent. The grain yield increased from 18.51 to 26.74 maunds.

In Uttar Pradesh, 'Banda' was recommended and multiplied until it could be replaced by one of the 'type 87 × Banda' hybrids. The Hybrid 251 bids fair to replace 'Banda'. K4, a high quality Kabuli gram of satisfactory yield, was selected from a sample from Sind. By hybridization between superior lines, about 200 cross combinations were made. These would be subjected to individual plant selection for the synthesis of superior varieties which might surpass Type 87 or hybrid 251 in yield, quality and earliness.

Arhar (Cajanus cajan)

Yield trials with six promising strains of *arhar* against the local was conducted at Behrampur, Chinsurah and Midnapur in Bengal for the fourth successive year, while the same experiment was conducted at Maldah farm for the second year. At Behrampur, type 10 and 7 gave the highest yields, while at Maldah and Midnapore types 10 and 3 gave the best performances. The trial of eight wilt resistant strains of *Cajanus cajan* received from the I.A.R.I. New Delhi, was

repeated this year for the fourth successive year at the State Agricultural Farm, Behrampur against type 62 as control. Wilting occurred in some of the plots and hence the types could not be said to be 100 per cent resistant. But the percentage of mortality was nil. To a wide range of material already available, 121 more samples were added during the course of the operation of the scheme in the Uttar Pradesh. Selection and yield tests have finally led to the isolation of types 1 and 3 as good, uniformly maturing and early, the former ripening in November and the latter in December when sown with the break of rains in June or early July. Among late *arhars*, which occupy most of the *arhar* acreage in the State, type 17 was successfully distributed for general cultivation.

Lentil (Lens esculentus)

The results in West Bengal indicated that the difference in yield due to different strains was highly significant. Strain No. 59 came out as the highest yielder with an average rate of yield of 25 maunds and 30 seers per acre. A trial of the second group lentil indicated that the difference in yield due to different strains was highly significant. The types T. 2 and T. 1 came out as the highest yielders with an average yield of 18 maunds and 20 seers and 16 maunds and 7 seers per acre respectively. An yield trial with six selected strains of lentil was conducted at the State Agricultural Farm, Behrampur, against Departmental Lentil No. 5 as standard. From the results it was found that the yield differences amongst the types were highly significant. The type C.T. 31 came out as the highest yielder; the Departmental variety gave very low yield.

Observations on the yields of cultures and varietal tests finally led to the multiplication of the seeds of Type 3 for general distribution, both because of its early maturity and its yield. Rotation experiments were started from 1943 with pulse and cereal crops. Mixed cropping with *arhar*, *urid*, *jowar*, *bajra*, *til*, *sawan* and pea was tried against single cropping. Under mixed cropping line sowing and sowing by broadcast were tried. On the whole *arhar* and *jowar* mixture proved to be a better combination than others, line sowing giving higher outturns than broadcast sowing.

Urid (Phaseolus mungo)

On the basis of the observations on the performance of the strains over several years the following types have been finally selected in Uttar Pradesh :

Type A-1 : a late strain of green *urid* of high yield for the trap soils of Bundelkhand.

Type 9 : an early strain of black *urid* of excellent performance.

Type 27 : a late strain of black *urid* of high yield and good quality for the alluvial areas.

Type 77 : a late strain of green *urid* of high yield for eastern districts of U.P. which prefer *urid*.

Moong (*Phaseolus aureus*)

The Moong Type 1, originally selected from a sample from Muzaffarpur (Bihar) was found to combine an extremely early maturity with high yield and to be good pulse variety to replace monsoon fallows and serve as a dual purpose grain-cum-green manure crop. Hybridization of Moong Type 1 with several other early and late types was carried out for the selection of hybrids of early and medium durations.

Soyabean (*Glycine max*)

The Type 63 was isolated from the soyabean varieties. It was better than the local in yield and quality but was only equal to the local in maturity period. This Type 63 was multiplied and the seeds were distributed to cultivators in the Uttar Pradesh.

Peas (*Pisum sativum*)

The type 19 has so far proved to be an excellent table-pea in the Uttar Pradesh because of its earliness, high quality and good yield. Hybridization between several varieties and table peas for further improvement in (a) earliness, (b) pod size and (c) yield has been carried out among several lines, and the segregating generations would be examined in future.

MIXED CROPPING

In Orissa the total income from the 60 lb. of paddy plus 15 lb. of *biri* per acre, was almost double of that of paddy under pure cropping. In Madhya Pradesh mixed cropping of gram with wheat was found to have an adverse effect on the yield of gram. The results from Madhya Bharat revealed that mixed cropping of *jowar*, *arhar* and *mung*, with seed rates in the proportion of 64 : 9 : 27 was most economic. The mixed cropping experiment in Hyderabad with *jowar*, groundnut and *tur* indicated that growing of one row of *tur* after every six rows of *jowar* gave the maximum economic returns.

PASTURELAND AND FODDER GRASSES

As proposed in the technical programme of the Grassland Reconnaissance Survey Scheme, a survey was undertaken in the Punjab, P.E.P.S.U., Western Uttar Pradesh, Baroda and its neighbourhood in the Bombay State, Assam and Manipur States, thus covering a part of zones 2 and 3. Owing to late start of the actual survey, it was not possible to include Rajasthan and to include many areas in the Western U.P. and Gujrat. These would be taken in later year under report, a total of 57 areas were examined, the number being 21 in the Punjab and P.E.P.S.U., 11 in the Uttar Pradesh, 2 in Bombay, 13 in Assam and 10 in Manipur.

Classification of types. Based upon the general botanical composition, characteristics of the species, soil conditions, topography and the general ecological principles, the sites are examined during the year and were tentatively classified into five broad types. Sufficient number of areas were examined for the first two types to provide a working description of these types. The types have been further classified into sub-types on the basis of the successtional

stages. These sub-types also reflect the condition of the grassland type. For other types only salient features, in particular the habitat condition and the nature of the grass and associated weeds, shrubs and trees, have been given.

Type I (*Dicanthium-Cenchrus* grassland type). The type has so far been found associated with the plains of Punjab, P.E.P.S.U., and Western Uttar Pradesh with a rainfall ranging from 10 to 30 inches. The soil appeared to be sandy to sandy loam in texture, slightly alkaline in reaction with frequently saline and alkaline patches and was moderately well drained. A total of about 32 grass species appeared to characterise this type, principal perennial species in order of importance being *Dichanthium annulatum*, *Cenchrus ciliaris*, *Cynodon dactylon*, *Eleusine flagellifera* and *Sporobolus pallidus*. All these were palatable to livestock. The characteristic annuals were *Aristida* sp., *Echinochloa colonum*, *Dragrostis* sp. and *Tragus racemosus*. **Type II (*Phragmites-Saccharum* grassland type).** This type was located in the plains of Punjab, P.E.P.S.U., Western U.P., Assam and Manipur States, mostly confined to low lying, ill-drained land over which water stood to a depth of several inches during most part of the year. Soils associated with this type varied from sandy to clayey in texture with alkaline to strongly acidic reaction. This type appeared to be represented by about 40 perennial and 24 annual species. This type (mainly used for thatching purposes) was generally subjected to annual fire, grazing being practised on the early spring growth.

Type III. The grasslands met with at Lalitpur, Jhansi and Baroda on transition zone between the alluvial and the true black soils, possessed their own characteristics. Most of the species found in this type included the recognised fodder grasses.

Type IV : The type was observed in the hills of Assam and Manipur States associated with red soils, clayey in texture and strongly acidic in reaction. The type was found to be represented by about 36 grass species. The characteristic perennial species were *Arundinella* spp; *Erianthus longisetosus*, *Thysanotus aenamaxima*, *Eulalia quadrinervis* and *Dimeria* spp.

Type V. This grassland type was associated with the sub-montane tract of the Punjab, U.P. and appeared to extend up to an elevation of 2000 ft. above sea level. The soil, neutral to slightly alkaline, was sandy loam in texture. The grasses of this type were found to be palatable and hence in these regions the dominance of these grasses should be maintained.

At the I.A.R.I., New Delhi, collection, maintenance and evaluation of the indigenous exotic materials was taken up. While 41 grasses and 33 legumes were planted in the observation plots during the last year, 132 strains of grasses and 46 strains of legumes were planted this year. The grasses included species of *Cenchrus*, *Dichanthium*, *Chrysopogon*, *Pennisetum*, *Bothriochloa*, *Chlores*, *Heteropogon*, *Bracharia*, *Digitaria*, *Urochloa*, *Paspalum*, *Cymbopogon*, *Andropogon*, etc. Besides these 40 strains of *Medicago sativa* and one each of *Clycine javanica*, *Desmodium discolor*, *Medicago falcata*, *M. glutinosa*, *M. media* and *M. arborea* were also planted.

With a view to test the drought resistance and hardiness of the various strains, different strains belonging to *Cenchrus ciliaris*, *C. seligerus*, *hydropogon montanus*, *Dichanthium annulatum*, *Pennisetum* sp., *Chloris* sp., *Urochloa* sp., *Panicum antidotale*, *Sorghum anuum*, *Brachiaria brizantha*, etc., were sown in an entirely rainfed area. Local strains of *Cenchrus* showed better germination as compared to the exotic ones.

At Dharwar, selection work in 'merval' (*Dichanthium annulatum*) was continued. Preliminary selections in *pavna* (*Schima nervosum*) and *Thelopogon elegans* were made. Feeler trials to determine suitable mixture of grasses and legumes for light red soil conditions were undertaken. The extent of natural re-seeding of grassland was tested by planting strains of grasses mixed with legume at intervals of 50ft. at right angles to the gradient of the grasslands, and allowing the seeds to fall when mature, in shallow furrows between the strips. The results were encouraging.

The yield trials of the promising grasses and other leguminous and non-leguminous fodders in Madhya Pradesh were carried out under rainfed conditions at Nagpur and under irrigated conditions at Seoni in randomized replicated blocks. Out of the nine grasses tried at Nagpur *Thelopogon elegans* (G 107) gave the yield of 28413 lb. per acre followed by *Pennisetum pedicellatum* (G 73) 25,821 lb. Sudan grass No. C. 194 was superior giving an yield of 15,700 lb. per acre. Neither the number of cuttings nor the periodicity of the growth of the annual types could be increased under irrigation except in the strains of Sudan grass.

The types of *Chloris bournei* (G 19) and thin *Napier* (G 305) gave 22,689 lb. and 22,227 respectively of green fodder under rainfed conditions and were superior to Rhodes grass, *anjan*, and *Eragrostis superba*.

ENTOMOLOGY

Termite Research Scheme, I. A. R. I.

A tour of several places in West Bengal, viz., Calcutta, Chinsurah Krishnagar and Midnapore was undertaken. In the various fruit trees examined, viz., mango, jack fruit, mulberry, citrus etc., the percentage of damage varied from 5 to 15 per cent., in sugarcane, from 5 to 7 per cent., in paddy ('aman'), and from 3 to 5 per cent and in *urid* it was 1 per cent. In other crops, the infestation was practically negligible. In Krishnagar and Midnapore where the soil was sandy loam and lateritic respectively, the incidence of termites was found to be severe whereas at Chinsurah, where the soil is hard clay, incidence of termites was much less.

The data of the experiment on the control of termites infesting wheat by means of insecticides were statistically analysed. It was concluded that the various treatments were effective in reducing the damage, but there was no significant difference in germination, tillering or yield with regard to the treatments given.

The biology of the two unidentified species of termites, the one collected at night in the laboratory and another collected from the bunds of sugarcane field was under study. Egg-laying was observed within two days of mating in both these species.

Termite Research Scheme (Taxonomy), Forest Research Institute, Dehra Dun. Taxonomic revision work on the following oriental termites was continued:

- (a) Work on the family Kalotermitidae, genera *Kalotermes* and *Neotermes* was completed. Some progress was made with the genus *Glyptotermes*.
- (b) With regard to the family Rhinotermitidae some progress was made with the genus *Coptotermes*.
- (c) In the family Termitidae some new species of *Eremotermes* and *synhamitermes* were discovered and partly described.

Termite Research Scheme, Anand. An account of the work carried out under the various items of termite research programme is given below :

Protection of mango and other fruit trees : Two mango orchards one at Padmala (Baroda District) and the other at the Institute of Agriculture, Anand, were selected for insecticidal experiments for the control of termites on mango tree trunks. From the data obtained, it could be concluded that amongst DDT w/d 50 per cent, DDT emulsion and DDT (5 per cent) in kerosene, the latter was found to be the most effective, as out of 24 trees, 18 trees with this treatment were not infested during a period of over 11 months. Comparing BHC w/d BHC emulsion and BHC, 5 per cent in kerosene, the latter was found to be superior as 17 out of 25 trees with this treatment were not infested for a period of 11 to 12 months. Among toxaphene w/d, toxaphene emulsion and toxaphene 5 per cent in kerosene, the toxaphene 5 per cent in kerosene was found to be the best insecticide, as 24 trees treated with this remained uninfested for a period of 11 to 12 months. Similarly between chlordane emulsion and chlordane 5 per cent in kerosene, chlordane 5 per cent in kerosene proved better as out of 22 trees with this treatment 18 trees remained uninfested for a period of 11 months. Among the DDT-groundnut oil, DDT-castor oil, DDT-mustard oil and DDT-karanj oil, DDT in groundnut oil appeared to be most effective, 0.063 Lindane in kerosene did not have much lasting effect. An adverse effect was noticed in the case of Pentachlorophenol which caused the oozing of gum from trunks. Looking to the different formulations the insecticide made in kerosene oil proved better.

Insecticidal trial in sugarcane. This experiment was conducted to test the efficacy of different insecticides against termite damage to germinating sugarcane sets. Except the 0.25 per cent BHC treatment, all the treatments gave significantly better germination than the control. The differences between these treatments were not significant.

Insecticidal trial in wheat. An experiment to test the efficacy of some insecticides for protecting germinating wheat from termite damage was laid down on a field-scale. It was seen that the stand of the crop with untreated seeds was the best, and it was poorest in the one treated with 2 per cent BHC paste. It should be stated, however, that difference between untreated, mercurial fungicide, 10 per cent DDT and 10 per cent BHC dust were not significant at 5 per cent level. The decline in stand after seed treatment with all the insecticide and fungicide was difficult to explain. The deleterious effect of insecticides appeared to be due to some soil factor, perhaps related to alkalinity of soil helping to release harmful substances from the insecticides used.

D. D. T. Scheme I. A. R. I.

DDT against termites in wheat and sugarcane fields.

The work was taken up by the newly constituted Termite Scheme of the Indian Council of Agricultural Research.

(ii) Bioassay of the comparative toxicity of the modern organic insecticides.

Athalia proxima. Dusting trials with the larvae of the mustard sawfly, *A proxima* showed that there was 100 per cent mortality with 0.25 per cent gamma-BHC, 79.2 per cent with 0.08 per cent dieldrin and 48.1 per cent with 5 per cent DDT against 20 per cent in the control.

Trogoderma granaria. Spraying trials against *T. granaria grubs* showed that there was 100 per cent mortality with 2 per cent aldrin, 90 per cent mortality with 0.5 per cent Folidol E605 and 66.6 per cent mortality with 1.75 per cent dieldrin.

Amsacta moorie. Larvae sprayed with the emulsions of DDT, gamma BHC, aldrin, toxophene, dieldrin, parathion and chlordane indicated that when used both as a stomach and contact poison, parathion was the most toxic amongst all, the tentative order of toxicity being parathion dieldrin gamma BHC DDT aldrin=toxaphene chlordane.

Studies on the persistence of the modern organic insecticides.

(a) 0.25 per cent and 0.5 per cent emulsions of DDT, aldrin, dieldrin, gamma BHC and toxaphene, sprayed on cauliflower, were found to persist for at least 32 days during November-December except for toxaphene 0.25 per cent which persisted for 20 days only.

(b) 0.125 per cent emulsion of dieldrin and aldrin, 1.0 per cent emulsion of DDT and 0.25 per cent emulsion of gamma BHC and toxaphene used as a spray were found to persist for 28 days on Knol-Kohl during January-February.

Studies on the phytotoxicity of the modern organic insecticides.

The following phytotoxicity was observed when used as a spray during September and October.

(a) DDT (0.5 per cent) and toxaphene (0.25 per cent) emulsions were phytotoxic to *gheeya* (*Lagenaria Siceraria*) while 0.25 per cent emulsions of aldrin, dieldrin and gamma BHC were partially phytotoxic.

(b) Toxaphene (0.25 per cent) emulsion was phytotoxic to *katchra* (*Cucumis pubescens*) (75 per cent of the leaves were burnt).

(c) DDT 0.5 per cent and toxaphene 0.25 per cent emulsions were slightly phytotoxic to *karella* (*Memordica charantia*).

Effect of Modern organic insecticides on the viability and freedom from pests of stored grains.

Two grains, maize yellow-2 and Rahar Mixed were treated with 10 per cent DDT, 0.5 per cent gamma BHC and 0.2 per cent pyrethrin dusts and stored under the normal conditions. The viability of both the seeds were not impaired by the following treatments and storage for the normal period.

(a) 10 per cent. DDT at 3 oz./125 lb. of grain.

(b) 0.5 per cent gamma BHC @ 4 oz./125 lb. of grain.

(c) 0.2 per cent pyrethrin @ 2 oz./125 lb. of grain.

As there was very little infestation in both the grains, treated or untreated, the effect of the treatments on the infestation was not very marked.

Field experiments on the efficacy of DDT, aldrin and dieldrin sprayings against boll worms of cotton.

The work on the spraying cotton with 0.125 per cent DDT suspension singly and in combination with aldrin and dieldrin (0.125 per cent and 0.125 per cent each of the two insecticides) as suspensions did not give encouraging results. Although significant difference was observed in the boll worm populations between the treatments towards the end of the spraying schedule, there was no significant increase in the final yield as a result of the sprayings.

D.D.T. Scheme, Bombay, Poona. The object of this scheme was to investigate the efficacy of different formulations of DDT, BHC and allied insecticides against important pests under Indian conditions.

Gujrat Hairy Caterpillars (Amsacta sp.). This lepidopterous pest is distributed in a wide region of North Gujrat and destroys germinating or young plants of maize, jowar, beans, cotton, and many other cultivated plants. As stated earlier, it was not possible to conduct any field trials and hence the caterpillars were collected from the fields even when it was raining. They were then exposed to a thin layer of different insecticides, where they were allowed to crawl about for a definite period and then removed and kept in cages for observation. They were given fresh food. The dead ones were counted after 24 hours. In the same way one pilot trial was laid out with water dispersible insecticide, where the food was held in the suspension, dried and fed to caterpillars. Except methyl parathion 1 per cent dust none of the others gave satisfactory mortality even under laboratory conditions.

Aphides. It was possible to secure one field of bottlegourd trailed on wires. Hence it was possible to lay out a detailed trial with (1) Nicotine 3 per cent dust (Bentonite) and (2) Nicotine sulphate (1:800). The results indicate that 3 per cent. Bentonite dust compared favourably with the standard spray.

MYCOLOGY

Plant Virus Research Scheme, I. A. R. I., Simla and Poona

Small-leaf disease of cotton. Varietal resistance tests have shown that the Tree Cotton is not susceptible whereas Uppam (H2919) and N.M.D. have proved to be susceptible.

Mosaic of papaya. Research for collateral hosts of the virus in nature has not been successful so far. Experiments on the control of the disease by cutting back infected plants showed that the method did not provide an effective control against the disease as the virus seems to move rapidly down from the crown.

Mosaic of banana. Studies on mode of transmission, varietal resistance, host-range, and insect-vector were continued. The virus was again transmitted to *Cucumis sativus* by juice inoculation but not to banana, *Lagenaria siceraria* or *Cucurbita maxima*. It was readily transmissible to banana by *Aphis gossypii* and seven banana varieties tested for disease resistance were found to be susceptible. However, the virus could not be transmitted to any of the six species belonging to cucurbitaceae, including *C. sativus*, by means of the aphid vector.

Yellow-vein mosaic of pumpkin. Studies on the host-range of the virus were continued through the agency of viruliferous white-flies. The disease was transmitted to one more host, viz., *Cucumis sativus*, out of 18 plant species tested.

Mosaic of brinjal. Studies on host-range and varietal resistance were continued. Four varieties of brinjal tested, viz., American Purple, Florida Market, 3-4-57, and 4-4-6-9, were found susceptible. The virus could not be transmitted to *Hyoscyamus niger*, *Carica papaya*, *Datura stramonium* and *Solanum torium*. The virus was not found to be seed-borne.

Mosaic of Datura metal. Studies on host-range and properties of the virus were continued. It was transmitted by sap inoculation to *Nicotiana longiflora* and *N. glutinosa* (percentage of infection into *Cucumis sativus*, *Vigna sinensis*, *Cyamopsis tetragonoloba*, and *Phaseolus vulgaris*. The thermal-inactivation and dilution-end points of the virus were between 60-70C., and 1:100-1:1,000 respectively. It could withstand storage for 144 hours in a refrigerator (about 500C) and did not appear to be seed-borne.

'Smalling' of tomato. Studies on host-range and insect vector were continued. The disease was transmitted by grafting to *Solanum melongena*, *S. nodiflorum*, *Nicotiana rustica*, *N. glutinosa*, *N. affinis*, *Patunia hybrida*, and *Nicandra physaloides*. Tests with white-flies, *Bemisia* sp., on *lycopersicon*, *esculentum*, *Datura stramonium*, and *Zinnia elegans* gave negative results.

Maize mosaic. The virus was transmitted by sap inoculation to *Brachiaria ramosa*, *Digitaria bifasciculata* and *Setaria verticillata*. *Phalaris minor*, a common weed, was found to carry it symptomlessly. *Toxoptera* sp., was shown to be an additional vector.

Sugarcane Mosaic. So far only the strain Y of Sugarcane mosaic virus has been detected. The virus was successfully transmitted by *Aphis maidis* and *Toxoptera* sp., to sugarcane varieties Co. 313 and *Surkha Saharanpuri* and also to Co. 213 by the latter.

'Grassy-shoot' disease. A serious disease of sugarcane causing stunting, bushy growth chlorosis and reduction in leaf-size was under investigation. Setts from canes obtained from infected stools produced diseased plants under glass-house conditions.

Yellow-vein mosaic of bhindi. Studies on the selection of resistant varieties and suitable breeding material for evolving resistant types showed that *Abelmoschus manihot* var *pungens* was not infected even when inoculated with 50 viruliferous white-flies. *Croton*

sparciflorus and *Ageratum* sp., common weeds, were found to be collateral hosts of the virus. The disease was also transmitted to *Zinnia elegans* through the insect vector.

Mosaic of sarson (*Barassica campestris* var. *sarson*). Studies on host-range, physical properties and insect-vector of the virus were continued. The virus was transmitted by sap inoculation to one more *Brassica* sp., i.e., Brussel's sprout (*B. oleracea* var. *gemmifera*), *B. alba* but not to cabbage (*Brassica oleracea* var. *capitata*), Cauliflower (*B. oleracea* var. *botrytis*), candy-tuft (*Iberis* sp.) Wall-flower (*Cheiranthus cheiri*), *C. Kewensis*, stock (*Mathiola incana*), *Mathiola bicornis* and *Hesperis matronalis*. It could not be transmitted to cabbage and stock even by grafting.

The thermal-inactivation and dilution-end points of the virus lie between 60-67°C., and 1:1000-1 : 1,000, respectively.

The aphid, *Macrosiphum granarium* Kirby, was found to be the vector of the virus.

Virus diseases of temperate fruits. A survey of orchards of apple, pear, plum, peach, apricot, and cherry in Simla Hills and Kulu-Valley revealed the prevalence, amongst others, of 'yellow-vein' mosaic of plum; mosaic of cherry and passion-fruit; and 'little-leaf' and 'yellow-mottle' of apple. Seedlings of temperate fruit varieties were successfully raised under glasshouse conditions and preliminary transmission tests by grafting were made.

Citrus. A disease causing chlorosis of veins and chlorotic spotting of leaves in citrus was transmitted in three grafts, indicating its virus nature.

Mango malformation. Some important mango tracts in U.P. were surveyed and preliminary transmission tests by grafting were made.

Miscellaneous studies. Investigations were continued on 'little-leaf' of brinjal; sterility of pigeon-pea; leaf-curl of linseed; mosaic of chillies, and sun hemp.

Development of new strains, serological relationships and cross-immunity tests

Mutation. Cross-immunity tests between *Cucumis* virus 2C and its mutant strain were in progress on *Cucumis melo*, *C. melo* var. *utilissimus*, and *Trichosanthes anguina* to study their relationship.

Cross-immunity tests. Experiments on cross-immunity between *Dolichos enation* mosaic virus and the common tobacco mosaic virus conducted on tobacco using different techniques confirmed the previous findings that the two viruses could establish and multiply simultaneously in tobacco without showing any antagonism.

Virus strains isolated from diseased tobacco plants. Investigations on the identification of virus strains involved in eight cultures were continued. The isolate, which produced systemic infection in *Nicotiana glauca* and was filtered from the complex by passing through this host, was studied in detail. It was transmitted by sap

inoculation to *Nicotiana tabacum* var. White Burley, *N. glutinosa*, *N. grandiflora*, *N. affinis*, *N. longiflora*, *Solanum nigrum*, *Retunia hybrida*, *Datura alba*, and *D. innoxia*. It could not be transmitted to *Cucumis sativus*, *Phaseolus vulgaris*, and *Gomphrena globosa*. Its thermal-inactivation and dilution-end points were between 70-80°C. and below 1:1,000 respectively. It could withstand storage up to 120 hours but not up to 200 hours at about 50°C.

Isolation and purification of virus

Preliminary attempts were made to isolate and purify the san hemp mosaic virus (Delhi strain) and the *Dolichos-enation* mosaic virus using different techniques of precipitation. However, only partially purified virus material could be obtained in both the cases.

Virus-vector relationship

Little-leaf of brinjal. The incubation period in its jassid vector *Eutettix phycitis*, was found to be 8 days during summer and 31 days during winter months. The viruliferous jassids could successfully infect healthy plants by one hour's feeding. They retained the virus throughout their lives. It was shown that the nymphs could also transmit the virus.

Mosaic of banana. It was found that a feeding period of 30 minutes was sufficient for the vector, *Aphis gossypii*, to acquire the virus from diseased plants.

'Katte' disease of cardamom. The aphid vector, *Pentalonia nigronervosa*, after acquiring the virus from diseased *Amomum* sp. of plants, lost its ability of further transmission after once feeding on healthy cardamom plants.

AGRONOMY AND SOIL SCIENCE

Phenological investigations

During the year, phenological observations were recorded on four trees, viz., mango, tamarind, neem and babul. The dates of occurrence of important phytophases like the flowering, fruit-setting fruit maturity were received from the reporting stations for all the four trees under observations. These were plotted on maps of India and isochrones for each phyto-phase were drawn. It was seen that with respect to the time of flowering, mango, and neem trees were somewhat similar, both flowering during the spring in the Peninsula, but the flowering of mango preceded that of neem. On the other hand, the tamarind and babul trees flowered during the south-west monsoon, tamarind flowering earlier than babul. Broadly speaking, in the case of all the four trees, flowering took place earliest in the southern parts of the country and was progressively later in the north. The isochrones for the date of flowering of the mango tree indicated that flowering occurred progressively later in the season as one moved from the southern to the northern regions of the country. Further, the variation in the time of flowering of the mango tree from the extreme south (about latitude 8°N) to the extreme North (about latitude 30°N) was roughly from the 1st of December of the 1st of March (90 days). In other words, the flowering of the mango tree appeared to be delayed by nearly four days for every

degree of latitudinal variation northwards. This appeared to be in agreement with the Bioclimatic Law formulated by Hopkins for North America.

Water requirements of crops

A scheme to develop experimental techniques for accurately measuring the water losses caused by transpiration from a plant (crop) and the inevitable evaporation from soil and water surfaces which appear to be associated with or occur side by side with the growing crops jointly called 'evapo-transpiration' was sanctioned for five years from March, 1954. The experiments on evapo-transpiration were intended to cover the different stages of crop growth and also to indicate the total evapo-transpiration during the entire life history of the crop.

In preliminary experiments it was found that the loss by evaporation from a large area of soil surface saturated with water was about 0.60 of the loss from the saturated U.S.A. evaporimeter one foot above the ground.

Evapo-transpiration. Observation on wheat (at the Central Agricultural Meteorological Observatory, Poona) showed that the daily loss of water by evapo-transpiration was about three litres from an area of 25 sq. ft. of the field in the beginning of December, increasing uniformly to about 9.5 litres by the middle of January, i.e., about a week before the ear-emergence (one litre=0.4 mm. of water). This period of maximum evapo-transpiration corresponded with the period of maximum rate of elongation of the crop. The loss of water seemed to decrease after ear emergence and particularly so after about two weeks of ear emergence. These preliminary observations of evapo-transpiration on wheat conducted at Poona on black cotton soil during 1954-55 appeared to indicate the water requirements of this crop during the different stages of its growth. Further experiments were in progress.

Production of weedicides and weed control

As in the previous years the manufacture of weedicides continued at the National Chemical Laboratory, Poona. The regional parts of this coordinated Weed Control Scheme also were continued in Madras, at the Bose Institute (West Bengal), in Bhopal and in the Himachal Pradesh. The results of experiments are briefly indicated up below :

Manufacture of weedicides. The manufacture of weedicides was taken up at the National Chemical Laboratory, Poona. The following weedicides were prepared.

2:4 Dichlorophenoxy acetic acid (2:4-D)

2-Methyl-4-chlorophenoxyacetic acid (M.C.P.A.)

Trichloroacetic acid (T.C.A.).

Ethylphenylcarbamate (E. P. C.) and isopropylphenyl-carbamate (Iso-P. P. C.).

Weed control trials. The results of the experiments on weed control are briefly described in the following paragraphs.

Cynodon dactylon. At Coimbatore (in Madras) spraying with sodium salt trichloroacetic acid at 50 and 100 lb. per acre was not effective in controlling this grassy weed. Butyl ester of 2,4-D at 10 and 20 lb. per acre, 'Stanvac' weed-killer at 25 and 50 gallons per acre and a mixture of these two at 10 lb. and 25 gallons respectively per acre gave only a temporary scorching effect. Flame spraying also was of no avail since the unaffected underground stolons put forth fresh growths within a week. Extra A was not at all effective against this weed.

Cyperus rotundus. At Coimbatore (in Madras) 'Stanvac' weed-killer at 25 gallons per acre in a single dose and in two doses at an interval of 30 days was of no use in controlling this weed. A mixture of 2,4-D butyl ester and MCPA at 5 lb. each per acre and in combination with 5 gallons of diesel oil per acre gave a good kill of this weed in four weeks. Extra A (Sandex) at 8 lb. in 100 gallons of water per acre showed only a temporary scorching effect on this weed. At Palur it was observed that a mixture of isopropyl and butyl esters of 2,4-D at 5 lb. each per acre gave the maximum mortality of 73.9 per cent. of *Cyperus*, a week after the treatment. The esters individually sprayed a 10 lb. per acre also showed a similar effect. At the Bose Institute (Bengal) *Cyperus rotundus* was killed by 1.25 to 7.0 per cent. of aqueous solution of 2,4-D and its derivatives, M.C.P.A., 2,4-5.T., Crag Herbicide and T. C. A. The time taken for complete killing varied from 7 to 20 days.

Imperata arundinacea. Similarly 1.5-15 per cent of these chemicals were required at the Bose Institute for killing the aerial parts of this weed, the time taken being from 10 to 30 days. Complete killing was however not effected and the plants revived. In the case of Na-T. C. A., there was no revival.

Rottboellia compressa. At the Bose Institute the concentration of the above chemicals required to the plant varied from 1.5 to 15.0 per cent and the time required from 7 to 30 days. Although the aerial parts were completely destroyed, there was occasional revival from underground stems.

Eichornia crassipes. At the Bose Institute the percentage of aqueous solution of 2, 4-D and its derivatives, MCPA 2-4-5. T., Crag Herbicide and T.C.A. required for killing the weed varied from 0.07 to 3.5. The time taken for a complete kill varied between 13 and 20 days depending on the herbicide used.

Ludwigia parviflora, needed 0.1 to 3.0 per cent., of the above herbicides for complete killing. The time taken was between 4 and 15 days.

Vicia sativa. Concentrations of these chemicals required varied from 0.5 per cent to 2.0 per cent. The weed was completely killed in 3 to 10 days, depending on the chemical used, by a concentration of 2.5 per cent of weedicides named above.

Kans (Saccharum spontaneum). Trichloroacetic acid was tried in Bhopal for the control of kans in the doses of 80 lb. 50 lb., and 15 lb. per acre. In all the treatments the foliage dried up within nine days of application. But after 11 days new shoots started coming up and continued growing.

Trianthema portulacastrum Esters of 2,4-D and sodium salt of MCPA at 3 to 5 lb. acid equivalent per acre completely killed the seedlings and scroched up the leaves of older plants to a marked degree in four days at Coimbatore (Madras).

Some new herbicides such as Extar A, Triherbide IPC and Triherbide NIX were also tried on a number of weeds for observing their herbicidal effect at Coimbatore. Extar A at 8 lb. in 100 gallons of water gave a complete kill of *Acanthospermum hispidum*, *Gynandropsis pentaphylla* and *Tribulus terrestris* within a week while it showed a temporary scorching effect on *Amaranthus viridis*, *Portulaca quadrifida*, *Trianthema decandra* and *Commelina forshalel*. Triherbide IPC (isopropyl phenyl carbamate) was not at all effective against any weeds and Triherbide NIX (sodium isopropyl xanthate) effected a good kill of many of the waste land dicot weeds such as *Leucas urticaefolia*, *Ruellia prostrata*, *Acanthospermum hispidum*, *Gynandropsis pentaphylla* and *Blepharis* sp., 2,4,5-T ester at 5 lb. per acre, is propyl ester of 2, 4-D and Brushkiller (Mixture of 2, 4-D and 2,4,5-T esters) at 10 lb., per acre proved to be effective in completely scorching up the root suckers of *Millingtonia hortensis*, *Morinda tinctoria* and *Capparis zeylanica* in about 15 days.

At Nanjanad, (in Madras) Trinerbide NIX at 20 lb. in 100 gallons of water per acre has been found to give the best scorching of both *Spurry* and *Oxalis* in 24 hours, closely followed by Extar A.

Manurial Experiments

The coordinated Manurial Trials Scheme (based on Dr. Stewart's recommendations) was in progress in the States of Madras, West Bengal, Bihar, Orissa, Bombay, Punjab, Bhopal and PEPSU. The results so far reported from Bihar, Bombay, Madras, West Bengal and Bhopal are briefly summarised below:

BIHAR

Simple manurial experiments were conducted in cultivators' fields in five centres of the Shahabad district namely Arrah, Dumraon, Bikramganj, Sasaram and Bhabua according to the approved technical programme. Fifty experiments on paddy and 50 experiments on wheat were laid out. These experiments generally showed good response to manuring the increase in yield varying from 6.93 to 180.8 per cent. The combination of N with P25 gave the best results on both paddy and wheat. The average increase in yield due to 40 lb. N/acre was 120 to 904 lb./acre in paddy and 368 to 576 lb./acre in wheat. On the addition of phosphate at the rate of 40 lb. P05/acre, an additional yield of 168 to 568 lb./acre in paddy and 56 to 464 lb. acre in wheat was obtained. Field observations in respect of morphological features of the soils on which experiments were conducted were collected. The surface soils were found to vary between sandy loam to clay-loam and clay texture.

BOMBAY

In both the zones (coastal and interior), in the district of Thana, response of paddy to nitrogen was higher and linear. In the coastal zone, the response to nitrogen was greater than in the interior. Sixty pounds of N plus 20 lb. of P.O. per acre in the interior were

found to be the likely doses for obtaining the maximum profits. In the district of Mehsana, the response to both the forms of N. (i.e., ammonium sulphate and urea) was good and linear with irrigated wheat. No significant difference was, however, noted, with either forms of nitrogen. The average increase in the yield at 20 lb. of N per acre was 30 lb. over the control. The increase due to addition of P₂O₅ was 195 lb. In the district of Nasik, no significant difference was observed between the two forms of nitrogen (i.e., ammonium sulphate and urea) at lower levels. The increase in yield due to 20 lb. of N per acre was 154 lb., with the addition of 20 lb. of P₂O₅ per acre to the nitrogen the increase was only 123 lb. acre.

MADRAS

In the Madras State experiments were carried on *Samba* paddy grown in 40 centres. In 41 out of 55 experiments the maximum yield was obtained in treatment with ammonium sulphate 30 lb. N/acre and superphosphate 30 lb. per acre over the basal dressing of green manuring (5,000 lb. per acre). Ammonium sulphate over the basal dressing of green manure gave the best result in six centres and green manure alone (5,000 lb./acre gave the best results) in five out of 55 experiments. The ryots method gave the best yield only in three of the experiments.

WEST BENGAL

The experiments were carried out in West Bengal in the districts of Hoogly and Burdwan. The soils of this area which were surveyed, could be divided into three broad categories, viz., (a) laterite, (b) red soils and (c) alluvium. The alluvium could be further divided into two families, viz., Ganga alluvium and Vindhya alluvium. The soils of each of these families could be subdivided further into a number of soil associations, depending upon their mode of formation and morphology, indicating similar profile characteristics and geography. Manual Trials with rice and jute were conducted in each soil group and associations for three seasons. The application of nitrogen invariably increased the yield of paddy (both grains and straw) in the district of Burdwan. The application of phosphate increased the yield much less as compared to that of nitrogen. In the case of jute the response to the application of ammonium sulphate at the rate of 150 lb. ammonium sulphate per acre gave an increase in the yield of dry fibre at all the places in Burdwan. Positive economical returns were obtained in each of the soil associations. In Hoogly an increase in the yield of fibre was obtained with ammonium sulphate in all the soils tested. The application of ammonium sulphate resulted in economical returns in all these places. An application of potash also resulted in an increase in the yield of jute fibre. The increased yield, however, was less than that obtained with ammonium sulphate. At the present price levels of muriate of potash and jute, the application of potassic fertilisers to increase the yield of jute fibre seemed to be economical.

BHOPAL

Manurial experiments on *jowar*, cotton and wheat were carried out in Bhopal in all the seven *tehsils* of Sehore district. A total of 37 experiments could be successfully conducted on *jowar*. The

manurial treatments gave heterogeneous results. Heavier doses of nitrogen (30 lb. per acre) gave better results. In cotton 39 experiments were conducted. The effect of superphosphate was very prominent on this crop which matured earlier than the others. But heavy precipitations in September developed an anaerobic condition in the soil due to water logging. This was responsible for shedding of buds and flowers. This shedding was maximum in the plots treated with P_2O_5 as the crops in these plots reached their productive phase earlier. The result shows a definite increase in yields in the plots treated with 30 lb., nitrogen and 15 lb. P_2O_5 per acre. The most remarkable feature was the percentage of seed cotton in individual picking. In all the treated plots the percentage of cotton was higher during first picking. The wheat experiments totalled fifty one. The interactions of nutrients in the plots treated with super phosphate were very favourable towards the growth and quality of individual plant. The plant grew faster, taller and attained maturity ten to fifteen days earlier. Though the yields in the treated plots were exactly uniform and homogeneous, yet the grain formation was better in the plots treated with superphosphate.

Application of Ammonium Sulphate to paddy lands of West Bengal

The scheme was first sanctioned in 1947 and was still in progress. The experiments were conducted at the State Agricultural Farms at (a) Chinsura, (b) Suri and (c) Berhampur. The height and number of the tillers of the paddy plants were increased by the application of ammonium sulphate in all the farms. The increase was continuous at Berhampur farm but at the Chinsura and Suri farms no further increase was obtained beyond the dose of 60 lb. N per acre. The plants receiving ammonium sulphate at a rate higher than 30 lb. N per acre are lodged at the Chinsura and Suri farms. At the Berhampur farm the crop did not show good growth and the plants receiving the highest dose i.e., 120 lb. N per acre are lodged. At Chinsura, bonemeal, farm yard manure and lime did not show any effect on the vegetative growth. On the other hand, farm yard manure had some effect on the formation of grain and straw at the Berhampur farm. The growth of plants was found to increase with the application of farm yard manure and bonemeal at the Suri farm. As to the effect of treatments on the yield at the Chinsura farm, the yield of grain and straw were increased only by the application of ammonium sulphate. Beyond the dose of 30 lb. N per acre, the yield of grain decreased with increasing the yield of grain and straw at the Suri farm. The dose 30 lb., N per acre as ammonium sulphate gave the highest yield of grain. Bonemeal has also increased the yield to a certain extent but lime altogether failed to do so. In the Berhampur farm also, both farm yard manure and ammonium sulphate increased the yield of grain and straw. There was no effect on the yield by the application of bonemeal or lime. From the results of soil analysis it was seen that practically no change had taken place in the composition of soil, by continuous application of ammonium sulphate. It appeared that doses of ammonium sulphate as high as 120 lb. N have had little effect on the soil, excepting a small change in pH or hardness in some cases; farm yard manure and bonemeal could counteract such effects.

Rapid methods of soil test for soil survey work at the I.A.R.I.

The scheme has been in progress since 1952. The scheme aims at the development of rapid soil tests for advising the farmers regarding the fertiliser requirements of their soils. The available P, K, and mineralised N of different soils were comparatively evaluated by various methods. Also, pot culture studies were undertaken for comparative correlation studies on P response with various methods.

Standardisation of methods of soil analysis, Bombay

This scheme has been in progress since 1953 at the Field Research Station, Bombay, under the supervision of Dr. A. N. Puri. The object of the scheme is to determine existing methods of soil analysis, selection of those suited to Indian conditions, correlation of the results of soil analysis with crop response and to find out methods of determining integrated quotients of soil fertility and evaluation of limiting factors.

NITROGEN FIXATION

Nitrogen fixation power of some leguminous crops in Madhya Pradesh

With a view to find out the causative factors of improved soil fertility in cases where the legume crops are cut and removed from the land, the Indian Council of Agricultural Research has sanctioned this scheme at various States, Madhya Pradesh being one of them. The experiments were conducted in the black cotton soil at Nagpur in Madhya Pradesh, and the leguminous crops, gram and berseem and the non-leguminous crop wheat were chosen for the experiments. It was observed that the nitrogen contents of berseem and gram in pots treated with phosphate were more than the non-phosphate ones. The results in case of berseem were, however, not statistically significant in the first two stages. There was a significant lowering of the nitrogen percentages in the soil after the removal of plants. It, therefore, appeared that the plants had not only taken up the nitrogen fixed for their complete growth but had also utilised a part of soil nitrogen. The nodules of the phosphate treated gram had fixed more nitrogen than the nodules of the non-phosphate gram.

Humification of organic matter in relation to the physioco-chemical properties of soils at Agra College, Agra

This scheme was sanctioned in 1953 for three years and has been extended for one more year to complete the work and conduct field trial. The scheme aims at studying the physico-chemical properties of soils on humification of organic matter and to correlate the effect of artificial humification on the fertility status of soils in Agra District which are very low in organic matter. It was observed that on the humification of leguminous *oainjji*, and *zoonzhru* the general level of nitrogen status of the humified soil was higher than the original soil during the whole period of humification.

Microflora of soils in relation to their structure and the role of earthworms in the alteration of microflora of soils

The scheme was sanctioned in 1954 for three years at the Indian Institute of Science, Bangalore. The object of the scheme is to study the microflora of a few selected black, red laterite, and alluvial acidic soils etc., in relation to their structure and to conduct microbiological experiments to determine the contribution of earthworms to the microflora of different soils.

With regard to the suitability of different green manure crops for rice, the following plants seemed to be promising.

For the main crop of paddy

- * (1) *Sunn hemp*
- (2) *Dhaincha*
- (3) *Sesbania sirecea*
- * (4) *Vigna sinensis**
- (5) *Phaseolus semierectus*
- (6) *Aschynomene americana*
- * (7) *Mung type No. I*
- * (8) *Crotalaria ussuriensis*
- (9) *Sesbania speciosa*
- * (10) *Guar*
- * (11) *Cassia leschenaultiana*

For the Second crop of paddy

- * (1) *Sunn hemp*
- * (2) *Mung*
- * (3) *Vigna sinensis*
- * (4) *Crotalaria brownei*
- * (5) *Crotalaria ussuriensis*
- (6) *Sesbania speciosa*
- (7) *Sesbania sirecea*
- (8) *Dhaincha*

* These crops are susceptible to water logging and they are not suitable for low lying areas. All the above mentioned crops can withstand drought considerably.

The following plants were found promising as perennials and their cuttings could be used for green manuring purposes for paddy lands.

- | | |
|---------------------------------|----------------------------------|
| (1) <i>Gliricidia maculeata</i> | (4) <i>Tephrosia candida</i> |
| (2) <i>Crotalaria striata</i> | (5) <i>Desmodium glyroides</i> |
| (3) <i>Crotalaria brownei</i> | (6) <i>Aschynomene americana</i> |

Green manuring crops for drought and water logged conditions

Most of the green manure crops tried were found to be drought resistant to a certain extent. *Tephrosia purpurea* and *Tephrosia noctiflora* were completely drought resistant. *Sesbania speciosa*, *Sesbania Sirecea*, *Phaseolus semierectus*, *Aschynomene americana*, *Cassia mimosoides*, *Alysicarpus rugosus*, *Alysicarpus vaginalis* and *Stylosanthes bojeri* were found to be resistant to water logging like the local green manure crop, *dhaincha*. All these types were equally resistant to drought conditions also.

Trials on the seedling ability of different green manure crops showed that all the *Crotalaria* species tried were heavy seed yielders. *Aschynomene americana* and *Tephrosia candida* had also

good seed setting capacity while the other varieties tried were very shy bearers as compared to *dhaincha*. With the other promising green manure crops, *Phaseolus semierectus* and *Cassia leschenaultiana*, considerable difficulty was experienced in the collection of pods as they matured irregularly and burst immediately after ripening.

Investigations on the nitrogen content of different green manure crops showed that *Tephrosia* species were rich in nitrogen compared to *dhaincha*. Among *Crotalaria* species, *C. ussuriensis* and *C. brownei* contain the highest percentage of nitrogen which was nearly double that of *dhaincha*. The rest of the varieties were on par with *dhaincha* in nitrogen content.

In the study of the optimum time and method of incorporation of green manure crops in the soil in relation to the yield of subsequent rice crop the yield figures indicated that the time of ploughing in was related to the age of the green manure crops. An eight weeks old *dhaincha* crop, which was quite succulent, gave a similar yield response when incorporated in either 4-6 weeks in advance or just before the rice planting, while 12 weeks old *dhaincha*, which was more woody had to be incorporated 4-6 weeks in advance of planting. The rice crop following 12 weeks old *dhaincha*, incorporated six weeks before the planting, gave a yield of 3506 lb. per acre as compared to 3188 lb. per acre obtained from the treatment where 12 weeks old *dhaincha* was incorporated at the time of planting. The compost made from the green leaves gave a similar response at the incorporation of green manure directly in the field.

In the experiment conducted for the second year to study the effect of growing *dhaincha* mixed with broadcast crop of paddy with or without nitrogen and phosphate application, confirmation was available of the results obtained last year that inter-cropping of *dhaincha* with paddy and incorporating it in the soil at *beushenin* gives an increase yield of 559 lb. per acre over the control, and this was equal in effect to the application of 20 lb. N alone as top dressing. The addition of *dhaincha* supplemented by 10 lb. and 20 lb. of nitrogen as sulphate of ammonia per acre as top dressing to paddy gave an increase yield of 915 lb. and 822 lb. per acre respectively.

In the experiment to compare the efficiency of *dhaincha* and sunn hemp grown *in situ*, and the green matter brought from outside for incorporation in the soil in conjunction with phosphate, ammonium sulphate and lime, the results confirm those of the last year that both *dhaincha* and sunn hemp give identical yield response. There was no significant difference between crop grown *in situ* and that brought from outside. The application of lime or phosphate or their interaction with *dhaincha* did not show any significant effect on the yield of paddy.

TUBER CROPS

Sweet potato (Ipomea batata)

In Madras State varietal collections were made at Coimbatore and Mangalore. At Coimbatore 64 varieties were maintained. At Mangalore a total of 127 types and crosses were under study and their morphological characters were recorded.

In Andhra State 75 types of Sweet Potato were maintained at Anakapalle Station and their morphological characters were recorded.

In Travancore-Cochin, the botanical characters, flowering habit and degree of fertility of all the varieties, i.e., 110 varieties so far collected at the station, were studied and recorded.

Varietal trials

In Madras State, varietal trials were carried out at Coimbatore and Mangalore. At Coimbatore, 18 varieties were under trial including the American and Chinese types. The type V. 8 (F.B 4004) gave the highest yield of 9,728 lb. per acre. At Mangalore, during the first crop season, eleven types, viz., F. B. 4004, T. S. T. white, T. S. T. Red, F. A. 17 white, F. A. 17 Red, B. 4304, B. 219, I. B. 33, I. B. 41, Moodabidri white I and Moodabidri white II were tested with local as standard. V. 8 (F. B. 4004) gave the maximum yield of 9,714 lb. per acre. All types except three, viz., Moodabidri White I, Moodabidri White II and B. 4304 proved superior to the local. In the second crop season, 16 types (viz., all the types named above plus I.B. 34, V. 14, V. 20, I.B. 40 North Arcot variety) were tested, and I.B. 33, F. B. 4004 (V 8), TST white (V. 12), I. B. 41, F. A. 17 white (V. 2), B. 219 and T. S. R. Red (V. 10) were significantly superior to the local. I. B. 33 gave the maximum yield of 5,968 lb. per acre and Moodabidri White II the lowest yield of 174 lb. per acre.

In Bihar, varietal experiments were conducted on Sweet potato types along with the local as standard. The trial was conducted in both the seasons. V. 2 a Chinese variety (F. A. 17, White) gave the highest yield in both the seasons.

In Bihar, varietal experiments were conducted on Sweet potato at Sabour with the following results :

Eleven selections from the local material were tested for their yields against the local commercial material. The yields of the selections, viz., S. P. 3, Panma, S. P. Lalka and S. P. 9. were markedly superior over the local commercial material.

The second clonal generation raised from the hybrid seeds (Ranger $\times$ locate I) were tested for their comparative yields against their parents. Cross 4 markedly out-yielded the parents.

Nine varieties obtained from the I.A.R.I., New Delhi, were tested against the local commercial material for their comparative yields. V-4 and V-1 of the I.A.R.I. were found to be superior in yield over others.

Six varieties of American origin were tested against the local commercial material for their comparative yields. There was no difference in yield between the local material and the two American varieties, viz., B 4004 and Ranger. The former was, however, found to be better in yield than the remaining four varieties of American origin.

Eight progenies obtained from pollinated seeds of different varieties were tested against the local commercial, but they were not found to be superior in yield.

In Orissa trials were conducted at the State Agricultural Research Station, Bhubaneswar. Sixteen varieties were put under trial, but they did not show any difference in vegetative growth; the yield differences were, however, significant. Three varieties, i.e., Ceylon, B.17, V4 and B. 69 gave yields of 1,519.44 lb., 1,404.12 lb. and 1,353.49 lb. per acre respectively as compared with the local Cuttack 1,237.67 lb. per acre.

In a yield trial with eight varieties of Sweet potato including two local varieties, the yield differences were not significant. But the yield figures indicated that Delhi-4 was the best of all, yielding 6,717.9 lb. per acre.

In the Punjab, V2, a Chinese variety named F.A. 17 white proved to be the highest yielding type giving as high as 200 maunds of tubers per acre. Every year and at all places, this variety gave 4 to 5 times higher yields than the local type. Its tubers were large in size, white in colour and altogether non-fibrous.

V6 (a Chinese variety) named as F.A. 17 Red, gave a high yield of 130 maunds of tubers per acre. Its tubers were long, thick, red in colour and altogether non-fibrous.

Agronomical experiments

In Madras State, cultural trials with vines from team cuttings versus vines from tubers were repeated for the fourth year in succession at Coimbatore and Mangalore. The yield differences were not significant.

Experiments with erect versus horizontal planting were conducted at Coimbatore and Mangalore. At Coimbatore the yield differences were not significant. At Mangalore the results were significant during the first crop season, erect planting giving 16.1 per cent higher yields over horizontal planting. The results were, however, not significant during the second crop season.

Spacing trials between ridges and flat beds were carried out at Mangalore and Coimbatore. At Mangalore, the results were not significant in both the first and second crop seasons. At Coimbatore, the trial was repeated with the variety V8. The cuttings were planted in beds and furrows with different spacings. The highest calculated yield of 5,417 lb. per acre was recorded with 2 ft. $\times$ 8ft. spacing in furrows.

A trial on long vines versus short vines was carried out at Coimbatore to find out the influence of the planting material on the formation of tubers and final yield with 8 and 9 inches long cuttings. The yield differences were not significant.

In Andhra State, a spacing trial combined with bed and furrow system of plantings was carried out. The cuttings were planted in both beds and furrows with the following spacing :—

2 ft., 3 ft., and 4 ft. between rows and 6 in., 9 in., and 12 in., between cuttings.

It was observed that the tuber size was not influenced in any way by spacings in both systems of planting, and the yield differences between the systems of planting were statistically significant. The bed system of planting gave an increased yield of 15.9 per cent over that of furrow system.

In Orissa, a cultural experiment was laid out to determine the optimum spacing and the right method of planting. Although the treatment differences were not statistically significant, it was observed that the flat bed planting with spacing 1 ft., between the lines and 6 inches between plant to plant within the line gave the best yield.

In the Punjab, it was observed that early plantings of the Sweet Potato gave significantly higher yields. Therefore, planting of the different sweet potato varieties from middle of May to middle of June, provided irrigational facilities were available, was recommended. Where irrigational facilities were inadequate, the crop could be grown successfully in the first fortnight of July with the onset of monsoon, in case only 3 or 4 irrigations were needed.

In spacing trials one foot spacing from plant to plant and one foot spacing from row to row gave the best result.

With regard to the pruning of vines it was observed that the pruning of vines in any manner decreased the yield.

It was also observed that the cuttings taken from upper portions of vines gave higher yields than those from the middle or lower portions.

Manurial experiments

In Madras State, the manurial trials were carried out at Coimbatore and Mangalore with the following treatments :—

Main plot treatments

- (a) A basal dressing of farm yard manure at 10,000 lb. per acre
- (b) A basal dressing of green manure at 10,000 lb. per acre
- (c) No basal dressing

Sub-plot treatments

- (i) N at 0.50 and 100 lb. per acre
- (ii) K₂O at 0.80 and 160 lb. per acre
- (iii) P₂O₅ at 0 and 80 lb. per acre

At Mangalore, the results were significant with regard to the main plot and sub-plot treatments. In main plot treatments, a basal dressing with green leaf gave the maximum yield of 11,955 lb. per acre. In the sub-plot treatment, nitrogen at 100 lb. per acre, potash at 160 lb. per acre and phosphoric acid at 80 lb. per acre gave the maximum yields of 12,607 lb., 12,846 lb. and 12,431 lb. per acre respectively. The combination of 100 lb. was followed by 160 lb. K₂O and 80 lb. P₂O₅ with 14,665 lb. and 100 lb. N and 80 N lb. P₂O₅ with 13,817 lb. of yield per acre respectively.

In Bihar, a manurial trial was conducted to test the effects of different organic and inorganic manures, viz., FYM, Ash and Ammonium Sulphate at the rate of 0 lb., 40 lb., and 80 lb. per acre, Potassium sulphate at the rate of 0 lb., 20 lb. and 40 lb. and super phosphate at the rate of 0 lb. and 40 lb. per acre. The effects of different manures were not markedly superior on the yield performance. On the other hand the effect of K was found to be detrimental which lowered the yield markedly. The joint effects of ammonium sulphate and potassium sulphate at different levels were, however, found to be different from one particular set of combination to another particular set of combination.

In Orissa, a N.P.K. manurial trial with three levels each of nitrogen and potash and two levels of phosphoric acid showed significant difference for phosphatic and potash treatment, but no difference for nitrogen treatment. The interaction effects were also not significant. A basal dressing of green leaf applied at 8,000 lb. per acre was significantly superior to no basal dose.

In the Punjab, it was observed that heavy doses of manures and fertilizers, when applied to the crop, caused excessive vine growth at the expense of tuber formation. Fifty pounds of nitrogen in ammonium sulphate, i.e., three maunds of ammonium sulphate per acre was found to be suitable dose for sweet potato production.

Miscellaneous experiments

In Madras State, 55 types were maintained at Coimbatore. Tubers of V8 variety of known weight were stored between alternative layers of sand, sawdust, straw and husk. The least damage to the tubers at the end of one month of storage life was recorded with tubers stored between alternative layers of sawdust.

Tapioca

In Madras State, 55 types were maintained at Coimbatore and the morphological characters of each type were recorded. At Mangalore, twenty nine types were studied for their morphological characters and yield.

In Andhra State, the varietal collection was maintained at Anakapalle station with the varieties transferred from Bapatla State. To this Travancore-105 and local were added.

In Travancore-Cochin, twenty-one new triploids were added to the existing 300 and odd varieties of tapioca farm at Trivandrum. These new triploid types were found to give a much better yield than the first set of ten triploids produced by crossing artificially produced tetraploids with diploids.

In Orissa four varieties were under observation. Travancore white was the best and the local people seem to like it because of its white appearance and sweeter taste than the indigenous variety.

Varietal trials

In Madras State the trials were conducted at Coimbatore and Mangalore. At Coimbatore the trial was laid out with 20 varieties and Malaivella recorded the highest yield of 9,075 lb. per acre. At

Mangalore, the trial was laid out with seven varieties. The difference in yield was not statistically significant. A maximum acre yield of 7,030 lb. was recorded by the variety Travancore 105, and the least yield of 2,939 lb. per acre by Sundari Vellai.

In Andhra State, a trial was laid with five varieties along with the local Samalkata as the standard. Of the five varieties, Travancore 105 did not establish in all the replications.

Cultural experiment

In Madras State the trial was conducted at Coimbatore to find out the yield difference when the sets were planted on mound and on ridges with 2 ft., 3 ft. and 4 ft., spacing between rows and 3 ft., 2 ft. and $\frac{1}{2}$ ft., between plants. The differences in yields were not significant.

In Orissa, a trial was carried out to compare the ridge method of planting with mound planting and to ascertain the optimum spacing. There was no significant difference between the different treatments. But the yield figures indicated that mound planting with 4 ft. $\times$ 4 ft., spacing was the best.

Manurial experiments

In Madras State a trial was carried out with Valenca variety using the same treatment as in sweet potato. The final data showed that nitrogen at 50 lb. per acre gave significantly higher yields than nitrogen at 100 lb. but differences between the levels 0 and 50 were not significant.

In Orissa, a N-P-K trial was laid out to study the effect of N, P and K fertilizer applications, with or without a basal dose of compost, on the yield of tapioca. Nitrogen application at 50 lb., per acre yielded significantly more than the control. But application of 100 lb. N per acre did not give a proportionate increase in yield. A basal dressing of compost also did not give any significant increase in yield over no basal dressing.

Colocasia : In the Punjab 83 types of colocasia were tried. S II was finally selected, being the highest yielding type with 464 maunds of tubers per acre. S 3, was found to be the second best type which yielded 454 maunds of tubers per acre.

Manurial experiments

In the Punjab, 100 lb. nitrogen in ammonium sulphate i.e. six maunds of ammonium sulphate per acre was found to be the most economical dose.

In Orissa a N-P-K manurial trial with two levels of nitrogen, phosphoric acid and potash was carried out. There was no significant response to the application of each of the three kinds of fertilizers. Also no interaction effect was significant.

Agronomical experiments

In the Punjab, four sowings were made on 20/2, 7/3, 22/3 and 6/4 in the year 1950-51 and 1951-52. It was observed from the yield data that optimum sowing time for colocasia could be third week of February to first week of March.

Under spacing trials various spacings of rows, viz., 1½ ft., 2 ft. and 2½ ft. were tried under different plant spacings, viz. 6 in., 9 inches and 12 inches. The most suitable distances were found to be 1½ ft. between rows and 12 inches between plants.

Other tuber crops

In Bihar, research on other tuber crops, viz., *misrikand* (*Pachyrhizus angulatus*), *suthni* (*Dioscorea fasciculata*), *haldi* (*Curcuma longa*) and *alti* (*Alocasia indica*) was in progress. Eight strains of *misrikand* were tested for their comparative yields. The strain T6 was found superior to others in yield.

In Orissa, research work on yam (*Dioscorea fasciculata*), Elephant foot yam (*Amorphophalus companulatus*) arrowroot (*Maranta arundinacea*) was in progress. Two varieties of yam were collected so far, one with pink stalk and pink tuber and other with green stalk and white tuber.

VEGETABLES

Brinjal

In Madras State, trial was laid out with thirty selections and observations recorded indicated that selection No. 28 (Tanjore) led the rest in respect of yield by weight giving 1 lb. and 2 oz. per plant on an average and that selection N. 30 (Coimbatore purple) with seven fruits per plant led in yield by number.

In West Bengal a trial with six replications of 16 types winter brinjal was laid out at Krishnagar. The analysis of variance of yield data showed that it varied significantly among the varieties at one per cent level of probability. The varieties, Krishnagar S. 45, Purple long European type, and All Season, were superior.

Tomato

In Bombay State, trials with 20 varieties of tomato conducted in *kharif* 1953, summer 1954 and *kharif* 1954 did not yield conclusive results because the promising varieties did not show consistency in their performance in each of the three seasons. This was due to the variability within the variety and high susceptibility of plants to the rugose and tobacco mosaic virus.

In West Bengal a trial with six replications of 10 types of tomato (selected from last year's trial) was carried out both at Krishnagar and Kalimpong. The analysis of variance of yield data showed that the results were insignificant even at 5 per cent. level of probability at Krishnagar whereas at Kalimpong it was significant at 1 per cent level of probability. The varieties long, Sioux, Nystate and Oxheart were found superior at Kalimpong.

In Bombay State, Inter varietal crosses between the cultivated variety *Lycopersicon esculentum* and its wild relative viz., *Lycopersicon peruvianum* and *Lycopersicon glandulosum*, were made with a view to breed tomato, resistant to the virus disease.

In Bombay State, in the *kharif* season of 1954 a few plants in the three tomato varieties, viz., 4 Open, Turiabla and No. 2680 were found to be affected. for the first time, by the 'Shoe lace' disease caused by the Cucumber mosaic virus. This disease did not appear in the *rabi*.

season but an other new disease showing the symptoms of purple-vein on tomato leaves appeared in such a virulent form that 68 per cent of the plants, particularly the young plants, were severely affected. In the pathological examination of the diseased plants, no fungus could be isolated.

In Bombay State keeping quality studies of 16 tomato varieties were conducted during the *rabi* season of 1954. It was observed that the keeping quality was associated with an appreciable loss in weight and size of fruit. The fruit of the variety No. 1085 kept up a marketable condition for 24 days but the loss in weight and size of fruit was 23.2 per cent and 32.5 per cent respectively, while in the variety No. 117 the fruit of which kept up marketable condition for 12 days only, the loss in weight and size of fruit was 8 per cent and 12 per cent respectively. However, the varieties No. 2598, No. 153 and No. 2680 showed a better performance in this respect.

In Madras State observational trials were conducted with five fungicides on tomato in the summer season. The treatments did not exert any beneficial or adverse effects on germination. But seeds treated with Harvesan, Agrosan G. N. and wet Ceresan gave more vigorous seedling.

Radish

In Madras State seven types obtained from private nurseries and the Central Vegetable Breeding Station, Kulu valley, were collected and put under observation. Of these Madras and White *Mullangi* gave better performance in general vigour and root development.

In West Bengal, a statistically laid out trial with five varieties (selected last year) showed that the varieties differ at 1 per cent level of probability in respect of their yields. The varieties Red-White tipped, Tibetan, Sidrapong, Chinese E.C. 383, gave good results.

Bhindi

In Bombay State 82 backcrosses and 20 fresh crosses between the high-yielding cultivated types of *bhindi* and its wild relative *Abelmoschus monihot* were made. Twenty-six reciprocal crosses were also made. In their crossing behaviour the F_1 hybrids and the reciprocal backcrosses were self-sterile producing seedless pods.

Out of the progeny of 82 backcrosses raised in the *kharif* 1954, 12 backcrosses only were found to be compatible producing viable seeds and the rest produced sterile seeds. In order to test the progeny of the compatible lines for resistance to the yellow-vein mosaic virus, all the 49 plants in this series were artificially inoculated with the white fly vector. Thirteen plants from our compatible lines showed complete resistance under field condition while the remaining plants showed varying degree of susceptibility. It was also observed that one plant out of two on each of the two accessions of compatible backcrosses segregated to resemble the F_1 parent and when these were backcrossed to their respective cultivated parents, the hybrid seed was found to be sterile.

Onion

In U.P. direct sowing of onion seed by seed drill was tried against the traditional method of transplanting the seedlings. Seed was sown

in the field as well as in the nursery on the same date. It was observed that the fields were similar, the bulb size in drill sowing was better, while the cost of cultivation was lower.

Under onion spacing trial a randomised block experiment with four replications and four different spacings (4 inches $\times$ 4 inches, 6 inches $\times$ 6 inches and 9 inches $\times$ 9 inches) was laid out. There was no significant difference in yield between the first three spacings, 6 inches $\times$ 6 inches and 4 inches $\times$ 4 inches, spacing recorded significantly higher yields than spacings of 9 inches $\times$ 9 inches. From the point of view of marketability of bulbs, spacings of 6 inches $\times$ 6 inches appeared to be desirable.

Pea

In West Bengal a statistically laid out trial with seven types of peas (selected from last year's trial) was made both at Krishnagar and Kalimpong. The analysis of variance of the yield data showed that the varieties were significant at 1 per cent level of probability both at Krishnagar and Kalimpong. The varieties Darantia Kaip, Phenomenon and Delvoche commando at Krishnagar and Telegraph, Bonneville, American Wonder, Alderman, and Early Giant at Kalimpong were found superior to others.

In U.P., an experiment with pea crop was laid out to study the effect of dates of sowing and seed treatments with fungicides on germination, incidence of wilt and yield. The time between the 24th October and 16th November were best for sowing. Earlier and later sowing gave lesser germination. Harvasan, Tillex, Ceresan and Agrosan G. N. were equally effective in increasing the germination percentage of seeds and were significantly superior in this respect to Tritisan. The least amount of wilting was observed when sowing was done on 24th October and 1st November. Earlier sowings recorded significantly higher percentage of wilt. Tritisan and Harvasan, were significantly superior in reducing the percentage of wilt, when compared with Agrosan G. N. and Ceresan (though Tritisan reduced germination of seed). Ceresan and Harvasan increased the yield of pods per plot significantly as compared to Tillex, Agrosan G. N. and Tritisan, the last recording the lowest yield. On the whole Harvasan was found to be the most suitable fungicide.

Cauliflower

In West Bengal, a randomised block trial with 10 types of cauliflowers was laid out at Krishnagar and with six types at Kalimpong. Snowball, Early Patna and splendid Pusa at Krishnagar and Snowball and Dania at Kalimpong were found to be superior to other varieties.

In West Bengal, experiments on planting time in relation to maturity (harvest) were conducted at Krishnagar and Kalimpong. At Krishnagar, a split plot design lay out six replications of two varieties of cauliflower and four different times of plantings, i.e., 4th week of August, September, October and November was laid out. August and September transplantings were significantly superior over the rest in respect of the yield of crop. At Kalimpong, the experiment was laid out with six replications and two varieties of cauliflower and three different times of planting, i.e., 4th week of September, October and November; September and October were significantly superior over the rest.

General

In Vindhya Pradesh, experiments on spacing were carried out on lady's finger, red gourd, cabbage, dwarf beans and knol-khol. Three varieties of lady's finger (Indian *bhindi* long, green smooth and long green non-smooth) were sown with three spacings ($1\frac{1}{2}$ ft., 2 ft., $2\frac{1}{2}$ ft.). The yield differences were insignificant.

In Himachal Pradesh, under varietal collection, 341 seed samples of the varieties of different vegetable types were collected both from within and outside the State.

In Bombay State in order to improve the yield of leafy vegetables and also their quality, earliness, disease resistance, etc., research work on *methi* (*Trigonella foenum-graecum* L.), *palak* (*Spinacea oleracea* L.) *chakvat* (*Chenopodium album* L.) and *rejgira* (*Amarantus paniculatus* L.) was in progress.

HORTICULTURE

Mango

At Hyderabad Fruit Research Station, the individual performance of Deccan Varieties of mango showed that Pittu was the earliest to blossom and had the longest flowering period (110 days) while Samare-Behishi had the shortest period (58 days). The variety Durr-e-Bahishit was the earliest to be harvested and Malgoa the last.

At Hyderabad Fruit Research Station the total number of varieties collected so far was 202.

Hybridisation work for combining desirable characters, was carried out using 35 combinations from which 39 hybrid fruits were obtained and were sown for trials.

At the laboratory of the Maharashtra Association for the Cultivation of Science, Poona (Bombay State), the Cytogenetical studies of mango were carried out for the elucidation of the genetic relationships of the wild and cultivated species of *Mangifera* and the cultivated varieties of Indian Mango (*Mangifera indica*) on the basis of their Cytology, morphology and geographical distribution. An examination of the chromosome numbers of 62 varieties of mango and four wild species of the genus *Mangifera* viz., *M. sylvatica* Roxb., *M. Calonoura*, Kz., *M. zeylanica* Hook and *M. Odorata* Criff showed a striking uniformity in the number of chromosome numbers having $n=20$ $2n=40$. The mango varieties were grouped into five classes each having 8, 10, 12, 14 and 16 nuclear chromosomes.

At the laboratory of Maharashtra Association for the Cultivation of Science, Poona, the causes of drop in fruit set in mango were studied. Non-germination of the pollen grains on the stigma of the female flowers resulted in a poor setting of fruits.

Citrus

Research schemes were in progress in the Punjab, U.P., Hyderabad, Orissa and Andhra with a view to finding out the best varieties, suitable scionic combinations and manurial requirements.

In Andhra State, root-stock trials were conducted on Sathgudi orange, Jamberi root-stock appeared to impart better vigour than others in respect of all growth features in general. In the lemon root-stock trial, Nepali Oblong when budded on Jamberi recorded the maximum growth increments in respect of scion and stock circumferences, while Gajanimma root-stock led others in respect of other growth features in general.

In the acid lime root-stock trials the differences among the different root-stocks were not significant in respect of fruit yields either by number or by weight and also fruit quality as judged by juice content and acidity. Similar non-significant differences were recorded in the lemon root-stock trials.

In Hyderabad State, under root-stock trials for Mosambi orange, seeds of several possible root-stock varieties were obtained and grown, but most of them had to be discarded due to poor germination. The varieties finally selected for trial were Jamberi (*C. limonica*) Kagzi lime (*C. aurantifolia*) Lime Sadaphal (*C. Sp.*) Mosambi orange (*C. sinensis*) and Rangapur lime (*C. sp.*).

In Coorg State, a comprehensive root-stock trial with Coorg orange on eleven root-stocks with unworked scion seedlings as control, was laid out in randomised blocks in September, 1953 with six plants for each treatment. The root-stocks used were Rough lemon (*Citrus Jamberi*). Sour orange (*Citrus aurantium*), Sweet orange (*Citrus simensis*) Sweet lime (*Citrus aurantifolia* V. Sasingh) Pumelo (*Citrus grandis*), Lemon (*Citrus limonia*), Grape-fruit (*Citrus paradisi*) Baduvapuli (*Citrus jajanimma*) Citron (*Citrus medica*) Mandarin Coorg (*Citrus reticulata*) and Seedling Coorg orange (*Citrus reticulata*) as control. Plants on sour orange, grapefruit and rough lemon were found to be vigorous and plants on sweet lime, mandarin, pumelo, lemon, and Baduvapuli were observed to be medium and satisfactory. Plants on citron were found to be very poor in growth and showed symptoms of deficiency diseases. The spread or the volume of plants on sour orange stocks, grapefruit, pumelo and Baduvapuli was the maximum. Plants on sour orange stocks were observed to be uniform with a good spread.

Another rootstock trial laid out in 1950 on Latine Square method in 4 blocks with 24 plants on each block showed some significant results. The stocks used were rough lemon, pumelo, sour orange, Baduvapuli, Mandarin and seedlings as control. Trees on Baduvapuli started bearing in the fourth year after planting *in situ* and produced large fruits. Trees on rough lemon were vigorous but the fruits were rather coarse and acid sugar blend was not good. Trees on sour orange produced uniform and medium sized trees. The compatibility and the quality of fruits were also good. Trees on pumelo were vigorous but bore large sized, coarse and insipid fruits. In vigour, rough lemon was the first, Baduvapuli the second pumelo the third and sour orange the fourth.

In order to find out the optimum manurial requirements of seedling orange plantations under Coorg conditions, an experiment was laid out in 1953. The treatments included ammonium sulphate, superphosphate, Potassium sulphate and groundnut cake in various combinations. The seedling plants one year old, were planted in

September. In order to standardize the soil, green manure crop (*Crotalaria juncea*) was raised and incorporated with the soil. It was observed that the plants given the treatment of ammonium sulphate one pound plus potash one pound, showed a relative increase in girth, height and spread, but the plants given the treatment of groundnut two pounds plus potash one pound showed a relative increase in girth and height but not to an appreciable extent in spread. The plants given the treatment of groundnut one pound plus superphosphate one pound plus potassium sulphate one pound decreased in girth and height but increased relatively in spread. In general it was observed that there are many variations among the girth, height and spread of the plants.

In the Punjab, under citrus manurial trials the treatments applied were (a) farm yard manure (b) ammonium sulphate (c) F Y M plus ammonium sulphate (d) control (No manure). Ammonium sulphate alone and in combination with farm yard manure gave significantly better results over control both in number and weight of fruits but both these treatments were at par with F Y M alone. Malta Pine-apple, Blood red and Common significantly out-yielded Hamlin and Valencia both in number and weight but were at par amongst themselves in these respects. The application of different manurial and fertilizer treatments failed to show any significant difference on the growth of Malta trees as measured by the stem girth. Treatments with F Y M alone, Ammonium Sulphate alone and control were at par amongst themselves in the production of juice and peel formation. F Y M alone produced significantly more juice than ammonium sulphate in combination with F Y M which was at par in this respect with ammonium sulphate alone and control. Ammonium sulphate plus F Y M gave significantly more peel percentage over other treatments which were at par amongst themselves.

The different treatments under trial failed to give any significant differences amongst themselves in the rag percentage as well as in total soluble solids. Treatments, control and F Y M alone, which were at-par amongst themselves and with the treatment F Y M plus ammonium sulphate induced significantly more acidity than ammonium sulphate alone which was at par with ammonium sulphate plus F Y M.

In Coorg State, a collection of important citrus species and varieties was made from India and abroad, the varieties collected were citrus Hystrich, Lime quats, citrang quat, Rangpur lime, Lemons, Sweet oranges (Hamlin, Ruby Blood, Joffa, Kothean Sweet, Homasasa, Larson's Brown and Kodur Sathgudi), mandarins, (Dancy Clomanthine and Khasi) and grapefruits (Marsh and Sicily). The growth performance of these were satisfactory.

Banana

In order to effect an all round improvement of banana crop by introducing better varieties and evolving better cultural practices, work was in progress at the Central Banana Research Station, Adu-thurai (Madras State) and two sub-stations, Ganeshkhind Fruit Experimental Station (Bombay State) and the Banana Research Station, Chinsura (West Bengal).

At the Central Banana Research Station, Aduthurai the collection consisted of 171 varieties. A detailed morphological description of 55 varieties has been completed.

At Ganeshkhind Fruit Experimental Station in all 99 varieties of banana have so far been collected, representing 72 table, 16 cooking varieties and 11 wild types. The variety 'Sahasrabali' was found to be promising as a table variety and the varieties 'Beula Kanch Kela' and 'Mendol' showed some promise as cooking varieties under Deccan conditions.

At the Central Banana Research Station, Aduthurai, de-suckering trial was relaid during January, 1953 with four treatments namely (a) all daughter suckers permitted to grow, (b) removal of all except the first daughter sucker, (c) removal of all except the first and third suckers, and (d) removal of all except the one that emerges after the parent plant has flowered. An analysis of the first generation data indicated that there was no significant difference among the differently suckering practices. However, they were found to be superior to no de-suckering.

Under spacing trial, two harvests were completed so far. In mean bunch weight per plant, the treatment 11 ft. $\times$ 11 ft. was leading while in total bunch weight treatment the 9 ft. $\times$ 9 ft. was leading.

At Ganeshkhind Fruit Experimental Station, under the study of mutants, one plant of 'Sonkel' variety produced a bunch weighing 18 lb. and carrying 20 hands and 218 fruits. The bunch was very compact and cylindrical. It was, therefore, felt that it might be a case of bud mutation as the parent plant from which it had originated was like any normal plant of the variety. The suckers of this plant are under observation.

The studies on the utility of bits of corms as planting material showed that 4 lb., 3 lb. and 2 lb. bits planted in pits and 4 lb. bits planted in furrows gave significantly better growth performance over the 2 lb. whole rizomes planted in furrows.

As regards yield of fruits, the differences between the various treatments were not statistically significant.

The vegetative growth of the plants appeared to be unaffected by the planting material separated directly from the mother plant and daughter suckers. However, the yield and the number of days taken for the plants to mature the fruit differed significantly.

In order to determine the optimum age of banana suckers and season of planting, growth, data were recorded. It was observed that either of these did not affect the growth of the plants as regards height and girth except in the case of the number of leaves produced. The data tended to show that suckers planted in March produced significantly larger number of leaves than those planted in June.

Experiments on the best methods of regulating and retaining the number of banana suckers for taking the ratoon crop revealed that the vegetative growth was a little better in the case of the plants in which suckers were not allowed to grow till flowering, as compared to those in which suckers were allowed to grow when mother plant was also growing. There did not appear to be any noticeable adverse effect of any of the treatments of ratooning on the vegetative growth of mother plants.

At the Fruit Research Station, Hyderabad the varietal collection consisted of two of *sitaphal* viz., crimson skinned *sitaphal* and white stemmed *sitaphal* and these were propagated by budding.

Washington 98797 and Mammoth were found to be the highest yielding varieties of custard apple. The highest yield from a single tree was recorded as 115 fruits.

Propagation studies in custard apple showed budding to be comparatively better than side grafting.

In all 333 crosses between *Annona Cherimola* and *Annona glabra* were made and fifteen fruits were obtained, from which 171 seeds were extracted and sown.

Grape-vines

With a view to combining prolificacy, high quality, aroma, disease resistance and seedlessness, hybridisation work was undertaken at the Hyderabad Fruit Research Station. Eighty male and female varietal combinations involving 340 inflorescences and 11,432 emasculated buds were crossed during the year. The number of successful combinations were 63, giving a total of 635 seeds from 989 berries which developed to maturity, and could be harvested. Of the varieties used as female parents, the varieties Kundhari and Alamwick gave a very high set of berries by crossing, but very few of these developed to full size to yield seeds.

At the Hyderabad Fruit Research Station, chemical analysis of grape-vine varieties showed Tor Sahebi White to contain the highest sugar percentage together with a high sugar acid ratio, and Gulabi, Fakhri and Forter's Seedling varieties ranking next.

Six varieties Bangalore Blue, Champanch, Large White, James, Oval White and Trentham Black which were previously found to be disease resistant to mildew continued to show resistance at the Hyderabad Fruit Research Station.

With a view to induce seedlessness in grapes by use of hormones a trial was undertaken at the Fruit Research Station, Hyderabad, with hormones 2-4-5 trichlorophenoxyacetic acid and B-Naph-thoxy-acetic-acid as water solutions in concentrations of 2, 5, 10, 25 and 50 p.p.m. with distilled water as control. Spraying on emasculated buds of the variety Bhokri was done from one to five times. A very low setting of seedless berries occurred. Only the hormone N.A.A. in concentration of 5 p.p.m. with five syrayings gave some set. However, the berries so set were very small in size as compared to the berries developed by either natural or artificial pollination.

Guava

At the Government Fruit Research Station, Saharanpur, a three gave a maximum yield of 1,793 fruits weighing 154 lb. and another tree of the same variety gave 1,646 fruits weighing 168 lb. 14 oz.

At the Government Fruit Research Station, Saharanpur, a root-stock trial with three root-stocks viz., (a) Airlayered stock of seedless guava grafted with *safeda* (b) *Safeda* seedling and (c) *Safeda* seedling grafted with *Safeda*, was carried out. As regards the girths of stock

and scion and trees spread, Air-layered stock of seedless guava grafted with *Safeda* occupied highest position. *Safeda* Seedling grafted with *Safeda* was the highest in respect of tree height. But there was no significant difference between the treatments.

At the Government Fruit Research Station, Saharanpur, inter-varietal crosses were made between Allahbad *Safeda* and seedless guava and also between Allahabadi *Safeda* and Lucknow 49 with a view to transfer less seedy character to Allahabadi *Safeda*. Different modes of pollination showed little difference in seed content of fruits. However, fruits had more seeds when left under natural condition as compared to self and artificial methods of pollinations.

At the Government Fruit Research Station, Saharanpur, to stabilise and purify the types of papaya, inbreeding was carried out in 16 promising types selected earlier. Out of these inbred lines seven types completed three rounds of line-crossing. Due to severe frost, seeds of low variability could be had only from 10 types.

At the Government Fruit Research Station, Bahadurgarh, Patiala the important *ber* fruit growing regions of PEPSU and Punjab were surveyed and ten varieties were earmarked for the collection of budwood to be used as scion. The varieties collected were Umran, Kaithli, Dandan, Chonchal, Dohra, Akhrota and Z.G.1. Z.G.2., Z.G.3., and Z.G.4. ('Z denotes *Zizyphus* and G denotes grafted'). Under the root-stock trials, the survey of existing root-stock material was undertaken and six distinct types of root-stock trees were spotted at different places. They were named as Zs-P1, Zs-P2, Zs-P3, Zs-P4, Zs-P5 and Zs-P6. The morphological characters of each type of root-stock were also recorded.

At the Government Fruit Research Station, Bhadurgarh, it was observed that root-stock Zs-P5 gave the best results as regard germination rati. All the seeds of this stock germinated and formed healthy seedlings. Other stocks also gave fair results except Zs-P2 where the rate of germination was poor.

It was observed that stones collected from fully ripe *Ber* fruits were generally viable. The stones collected haphazardly from underneath a *ber* fruit tree contained a large percentage of non-viable stones (50-70 per cent). The stones that kept floating when immersed into a 17-18 per cent salt solution were discarded as non-viable. The seeds extracted by breaking the stones started germination in about a week's time after sowing.

Cashewnut

In Madras State, seeds were collected from East Africa and Brazil and from Madras, Travancore-Cochin, Andhra, Bombay, West Bengal, Mysore and Orissa States. The seeds of 105 individual tree selections were shown in the field. Germination and growth of all the seedlings except 10 were found to be satisfactory.

In Travancore-Cochin State, a survey of the Cashew growing areas was made and morphological study of the tree, leaf, flower and characters of 186 trees were recorded. On the basis of the weight of nuts, the types were classified under three groups:

Group I—50 nuts or less made 1 lb.

Group II—51 to 75 nuts made 1 lb.

Group III—76 or more made 1 lb.

All the high yielding trees were found to be coming under Group II. Trees having nuts under Group I and III were poorer in their annual yield.

A study of the kernel percentage after roasting and shelling the raw nuts showed that the Kernel content of the heavier nuts (Groups I and II) was 2 to 5 per cent more than that of the light nuts of Group III.

In Madras State, the propagation trials on Cashewnut were carried out. Layering by the common 'ring' and 'tongue' methods showed that although root formation in the former was somewhat satisfactory, it did not appear possible to keep the separated plants alive for more than two months. During June and July, rooting was poor. The tongue method of layering was a total failure. Air-layering of shoots through the method of cincturing using Alkathene (Polythene) wrappers was found to be promising with one year old and current seasons shoots, the average success in rooting by the former method worked out to 76.4 per cent while the percentage of success with the latter was 66.4. Monthly trials in anarching gave encouraging results, particularly in the month of November, when 100% success was recorded. A new method of grafting resorted to in November, 1954, gave encouraging results.

In Travancore-Cochin State, propagation trials consisted of side grafting, budding, rooting of stone cuttings, inarching and serial layering. Inarching and aerial layering were found to be definitely promising in the vegetative propagation of Cashewnuts.

Fruit preservation

Schemes for training in fruit and vegetable preservation were in operation in the Punjab, Assam, U.P. and Madhya Bharat. The aim of these schemes was to train persons, especially women, so as to encourage them to practise fruit preservation in homes.

General

At the Government Hill Fruit Research Station, Chaubattia (Almora), researches were carried out to evolve suitable methods of the improvement of spent up orchards in the Kumaon hills. Application of lime and superphosphate improved the soils both in nutrient status and in physical properties and raised the status of exchangeable calcium, exchangeable magnesium and exchangeable potash and available P_2O_5 . The rate of improvement was more or less proportionate to the quantity of superphosphate supplied to the soil. Through single lime treatment caused some improvement, it was much slow and less marked on the soil as compared to the double lime treatment. Double dose of lime with superphosphate brought about a distinct improvement in the water holding capacity, moisture equivalent and the soil reaction.

SPICES AND MISCELLANEOUS CROPS

1. Pepper Research Scheme, Madras

Varietal collection. Seventy-seven varieties and types have been collected together and are under study.

Morphological studies of different varieties and types. The sexual composition of the flowers of the variety Vally, produced in the normal season in June-July and later in September, was studied and it was found that September-formed spikes produced a preponderance of the female flowers, unlike the normal season spikes which produced a preponderance of bisexual flowers.

Blossom biological studies and hybridisation of pepper. Studies to find out if there was any parthenocarpic development of berries in pepper, and it was found that fertilization was absolutely essential for berry development.

Studies of the incidence of Polu (hollow-berry). Data on the incidence of polu in three varieties Kalluvally, Balankotta and Uthirankotta, both in dense shade and in open situations, were recorded. The studies revealed that the Travancore varieties were more susceptible to pollu than the Malabar varieties, Kalluvally and Balankotta, and dense shade was more conducive to a greater incidence of pollu which appeared in September, and increased as the season advanced. A trial to control the incidence of pollu, caused by flea beetle attack, by spraying 0.1 per cent DDT and 0.05 per cent BHC on the vines was carried out. Observations on the life history and habits of the pollu flea beetle were made and recorded.

Studies on spike shedding. Data in respect of the number of spikes shed from two vines of each of the three varieties, Balankotta, Kalluvally and Uthirankotta in open as well as shady situations were recorded at weekly intervals from the first week of July, 1954 till the harvest in February, 1955. The data recorded during the year under report, revealed wide variability on the extent of spike-shedding between individual vines of the same variety as well as between the different varieties. The extent of spike shedding, in different years, from the same vine was also found to vary considerably.

Propagation studies. Monthly inarching trials of Kalluvally on rooted cuttings of pepper varieties Uthirankotta and *Piper attenuatum* were carried out from August, 1954 to June, 1955 to determine the optimum month for the operation. From the data recorded so far, the period from October to January was found to be most suitable for the operation.

Trials on side-grafting single-node-cuttings of Kalluvally on rooted cuttings of Uthirankotta and *Piper attenuatum* were carried out and it was found that single-node-cuttings could be very successfully side-grafted. The possibility of side-grafting and inarching pepper on beetle vine was investigated, and it was found that pepper could be side-grafted and inarched on beetle vine easily.

A trial on seed propagation to determine the pre-treatment necessary for satisfactory germination of the seed was carried out and it was found that seeds sown without seed-coat gave a slightly quicker germination as compared to the seeds sown with seed-coat. No marked difference in the percentage of germination between seeds with and without seed-coat and seeds sown immediately after collection and after drying in shade for three days was noticeable. From the data recorded, it was found that pepper seeds dried for three days in shade or not dried and stored for 20 days from the date of collection did not lose their viability.

A trial to find out if the position of the seed in the seed bed had any influence on germination, seeds were sown with the stigmatic end up and with the stigmatic end down. The latter method of sowing resulted in a slightly quicker germination, but the former method of sowing gave better germination.

Top-working trial of old Uthirankotta (pure female) with shoots of hermaphrodite types which have already developed lateral fruiting branches, to make the former more productive.

The shoots of Kalluvally and Balankotta with lateral fruiting branches top-worked in 1953 developed spikes in 1954 and 1955. It was found that the Uthirankotta vines developed spikes and flowered earlier than the top-worked shoots of Kalluvally and Balankotta, though there was slight over-lapping of the flowering phases of the Uthirankotta vine and the top-worked shoots. No difference in berry-setting between the vines of Uthirankotta top-worked and the unworked Uthirankotta vines was noticeable. This was due to the fact that only a few spikes were available on the top worked shoots of the hermaphrodite types.

Ginger Research Scheme, Madras

Varietal. Due to the loss of all the varietal collections in 1953-54, fresh attempts were made to collect varieties of ginger from various parts of India. So far only six varieties have been collected.

Cultural influence of varying tilth and time of planting. The yield differences were not significant in respect of the main treatments, viz., number of ploughings. Planting on the 15th June was found to have recorded very poor yields. Planting on the 1st May, 15th May, and 1st June were found to be at par with each other and superior to planting on the 15th June. The interactions between the main and sub-treatments were not significant.

Effect of different seed rates and spacings on yield. A seed rate of 1,400 lb. per acre resulted in yields, statistically higher than those obtained from adopting seed rates of 1,200 lb. per acre, 1,000 lb. per acre and 800 lb. per acre. Spacings of either 12 in. $\times$ 12 in. or 9 in. $\times$ 9 in. resulted in yields statistically higher than the yield obtained from adopting a spacing of 6 inches $\times$ 6 in. The interactions between the main and sub-treatments were not significant.

Effect of shade on yield. The crop in the open recorded an yield 12.6 per cent higher than the general mean. The results were statistically significant but contradictory to results obtained in the previous year.

Manurial

Mulching experiments. Muching thrice with green leaves at the rate of 5,000 lb. per acre each time and mulching twice with green leaves at the rate of 5,000 lb. per acre each time were found to be superior to all other treatments.

Curing trials. The dry ginger obtained after treatment with lime water had the desired appearance and colour. The use of the turmeric polisher resulted in a finished product which was poor in quality

Preservation trials. The mature crop retained in the open field without harvest under a thick mulch of green leaves, was found to be the best preserved.

Zira Research Scheme, Rajasthan

Isolations from the diseased roots and stems of wilted plants from Malpura tehsil yielded the fungus *Fusarium*, which again produced the disease in *zira* in pots and was reisolated from the diseased plants.

Histological studies showed the presence of the mycelium and chlamydospores mostly in the vascular tissues, some times reaching the central pith and cortex also in later stages.

The fungus showed a wide growth range of temperature, the maximum and the optimum being 35°C. and 24°C. respectively. The thermal death point was found to be 70°C.

The maximum linear growth of the fungus was found to be at pH 6.6 although the ranges up to pH 4.8 and 8.4 were also suitable for its growth. At pH 8.6 however, growth slowed down considerably.

Turmeric Research Scheme, Orissa

In yield trial experiments of extra-state samples, *Betul* variety was as good as *Shillong*, but the former was better than *G. Udhayagiri* whereas the latter was not.

In the cultural experiments to study the relative merits of planting mother and daughter rhizomes of turmeric with different spacings with a view to find out the right type of seed materials and the spacings required for plantings, it was found that the variation due to both spacing and type of seed was significant. The mother rhizomes yielded better than the daughter rhizomes. As regards spacing, the tendency to yield better with narrower spacing was evident.

In the study of the optimum depth and time of planting of turmeric rhizomes, the results showed that the depth of sowing had no significant effect, but the effect of date of sowing varied significantly from date to date. Actually very late sowing lowered the yield.

As a result of the studies on the effect of mixed croppings of turmeric with *ragi*, *dhanicha* and sann hemp, it was observed that turmeric mixed with sann hemp was as good as turmeric grown alone. They were both better in yield than mixed with *ragi* and *dhanicha*.

In an experiment to study the effect of varying doses of organic and inorganic nitrogen on the yield of turmeric it was found that ammonium sulphate when applied in doses of 120 lb. and 90 lb. nitrogen/acre gave identical results. Inorganic nitrogen in general was more beneficial than organic nitrogen applied as niger oil cake. Niger oil cake applied in doses of 120 lb., 90 lb. and 60 lb. nitrogen/acre gave a similar performance.

In order to find out a substitute for leaf-mulching in other kinds of organic manures, a yield trial was conducted, and it was noticed

that farm yard manure gave the best result. It surpassed *sal* leaf-mulch. *Sal* leaf-mulch, compost, fresh cattle dung and niger oil cake gave similar performance. Fresh cattle dung and *sal* leaf-mulch proved better than castor oil cake and soil dust mulch, whereas compost and niger oil cake behaved alike.

Chillies Research Scheme, Andhra

Family blocks and corresponding small bulk yield trials. Fifteen promising cultures comprising six old and nine new families were studied in two series in comparison with G. 2 as the control. The yields were analysed including the sibs of the families. The pod characters like length and girth of pod, seed percentage, shape and attachment of clay and pod colour were examined. In series I of the small bulk trials, the culture CA 452-1 maintained its significant superiority as in the last year over G. 2 with 20 per cent increased yield, while it was pure for yield in family blocks. This was advanced to bulk yield trial. In series II of the small bulk trial, six cultures gave significantly better yield over G. 2 but only five of them, viz., CA407-1, 280-1-1-, 276-2-1, G. 1, 215-1-2 were pure for yield in family blocks. These were also advanced to bulk yield trials. These cultures, viz., CA 662, G. 1 186-1-2 and CA 456-2 were retained for further study.

Replicated row yield trials. Altogether 46 promising cultures were advanced for further study.

Second generation hybrid progenies. It is interesting to mention that all the hybrid progenies of G. 1 and G. 2 with C. 8 and C. 9 (Mexican types) consisted of highly desirable types having better pod size, colour and prolificity when compared to G.2 and G.1.

Study of indigenous and exotic types

Morphological descriptions have been recorded of 130 indigenous and 80 exotic types.

Fundamental Preliminary studies of pungency of chillies. Representative samples were taken from the various chilli collections on hand and their dry pods were analysed for assessing their pungency. The colour index indicating the pungency values were found to agree almost with the commercial gradation in most of the varieties, viz., (i) very hot, (ii) hot, (iii) mild pungency and (iv) negligible pungency.

Seed viability studies of chilli. The viability of chilli seeds when stored for one year, two years, three years both as pod and seed was examined; the three-year old material had no germination. The trial indicated that the material can be preserved up to one year either as pod or as seed without detriment to the germination capacity.

Manurial trial on chilli. The yield differences between major treatments ('green manure' and 'no-green manure') were not significant while significant differences were observed in sub-treatments.

The treatment receiving 60 lb. nitrogen applied in combination of P_2O_5 and K_2O in both 'green manure' and 'no-green manure' series recorded highest yield. In both the major treatments sub-plots receiving 60 lb. nitrogen and 40 lb. nitrogen gave uniformly and significantly higher yields over the treatments receiving 'no-nitrogen'. In 'no-green manure' series the 'all fertilisers treatment' (60 N. 30 P_2O_5 and 50 K_2O) had almost doubled the yield of ripe chilli obtained from 'No-manure' treatments. Similar was the case in 'green manure' series also where the yields were enhanced by 80 per cent by 'all-combination' treatments. The mere addition K_2O , P_2O_5 or green leaf individually or in combination did not enhance the yields in the absence of nitrogen. An increase in the level of nitrogen from 40 lb. to 60 lb. per acre failed to give sufficient significant increase in yields except when applied in combination with P_2O_5 and K_2O . The presence of nitrogen was found to be directly responsible in increasing the rate of growth, fresh weight of plant, stalk weight and finally the yield.

MEDICINAL PLANTS

Medicinal Plants Scheme, Forest Research Institute, Dehra Dun

Experimental cultivation of the following medicinal plants was continued or taken up during the year under report: *Rauwolfia serpentina* Benth, Ex-Kurz, *Podophyllum hexandrum* Royle, *Rhamnus purshiana* DC, *Duboisia myoporoides* R. Br., *Mentha piperita* Linn., *Dorris elliptica* (Roxb.) Dent., *Derris malaccensis* Bran., *Urgenea maritima* (Linn.), Bakery, *Dorris Artemisia* Spp., *Chrysanthemum cinerariaefolium* Viss., *Atropa acuminata*, Royle ex Lindl., *Atropa belladonna* Linn., *Hyoscyamus niger* Linn., *Chenopodium ambrosioides* Linn., Var. *anthalminticum* Gray, *Digitalis lanata* Ehrh., *Digitalis purpurea* Linn., *Dioscorea deltoides* Wall., *Ephedra Gerardina* Wall. and *Euonymus alhpurpureus* Roxb.

The work so far done gave promising results in many cases, particularly with regard to *Rauwolfia serpentina*. In addition to the useful cultural and economic work for investigating the optimum condition of exploitation of the drug, interesting results having a far reaching practical bearing on the cultivation of the plants were obtained. Experiments indicated that, for commercial purposes, it was best to cultivate *Rauwolfia* through seeds, as vegetative methods of propagation through root cuttings and stem cuttings gave comparatively a much lower yield of roots.

Interesting data have also been obtained with regard to the cultivation of *Artemisia brevifolia*. Whereas it had been observed in previous years that the plant could not be successfully cultivated at Chakrata with an annual rainfall of about 65 inches, encouraging results were obtained with the plant at Kathian (25 miles from Chakrata) with an annual rainfall of about 50 inches. In the latter area the survival of plants was found to be about 93 per cent and samples so far analysed indicated santonin content of 1.9 per cent. This compared favourably with the yields obtained from *A. brevifolia* from anywhere in its natural habitate. In fact it was appreciably higher than that reported from most other areas.

Cultivation of *belladonna* at Chakrata also showed promising results. It was believed that the alkaloidal content of its leaves was highest at the flowering stage, but the experiments indicated that

the alkaloidal content was the highest when the flower buds were in the primordial stage, and the amount of total alkaloids decreased as the development of flowers progressed.

Medicinal Plants Scheme, Jammu and Kashmir State

The following medicinal plants were successfully introduced :

1. *Rauwolfia serpentina*
2. *Artemisia maritima* (Japan)
3. *Pogostemon patchouli*
4. *Ammi vis-naga*
5. *Colchicum autumnale*
6. *Ocimum kilimandscharicum* (Camphor yielding) (Tulsi)
7. *Salvia officinalis*
8. *Thymus vulgaris*
9. *Rosa centifolia*
10. *Rosa damascena*

In a manurial experiment on *Belladonna* it was found that lime increased the percentage of total alkaloids. Ammonium sulphate also gave good results. It was further observed, that little mortality occurred if at the time of transplanting, the root system of the seedlings was dug out along with some earth and if the excess of the leaves was removed before transplanting. In another experiment it was observed that 8 inches depth of tillage and the spacing of plants $1\frac{1}{2}$ ft. to $2\frac{1}{2}$ ft. apart gave highest yield of alkaloid.

In a manurial experiment with *Digitalis purpurea* it appeared that lime gave best response and was followed by ammonium sulphate. In alkaline soil plenty of nitrogenous fertilizer would have a good effect, and chilean nitrate, the action of which in the soil is non-acidic and which is a nitrogenous fertilizer, would be the most suitable fertilizer for this purpose. However this needed further confirmation. Spacing of the plants 12 in. apart and shallow tillage (4 in. deep) gave best results. Experiments on *Digitalis lanta* also gave results similar to those obtained with *Digitalis purpurea*.

Mentha Arvensis

In the manurial experiment with *Mentha arvensis* one important point of note was the very high yield of oil which was obtained in Jammu weather in all treatments including control (3.5 to 4 per cent against 1 to 2 per cent reported in Japan, U.S.A. and Brazil).

Suitable strains of *Ocimum killimandscharicum* were selected and multiplied vegetatively to study the plant. Though the plants did very well and its oil contained a good quantity of camphor, its large-scale cultivation was not likely to be economical due to competition from synthetic camphor.

Medicinal Plant Scheme West Bengal

Various medicinal plants were experimentally cultivated. The seeds of *Hyascyamus niger* were sown well-mixed with dry earth

to facilitate even distribution by broad-casting. Mustard-cake, bone-meal and ammonium sulphate aided healthy growth of these plants. Seeds sown in August germinated well. Necessary steps were taken to acclimatise them in suitable areas. The chemical contents were found to be satisfactory.

Plants of *Mentha piperita* (peppermint oil) transplanted 1 ft. × 1 ft. apart during May/June were all growing well. It liked moist and semi-swampy land near the water courses for its luxuriant growth. Chemical analyses revealed the total volatile oil content in air-dried samples to be as high as 1.7 per cent V/W (B.P.C. standard is 0.5 per cent to 1.5 per cent) and the yield was still higher when fresh plants were analysed.

The cultivation of the emetine-yielding *Ipecac* plant was taken up in July, 1953. Steps were taken to control some insects and plant diseases with which plants in certain cases were attacked. *Psychotria erractica* was introduced into the plantation with the idea of natural hybridisation in order to improve the health of the plants and to increase their emetine content. Cuttings planted in the month of May gave the highest percentage of rooting. The experiment on the effect of treatment with various concentrations of L-naphthalene-acetic acid on the rooting of cuttings did not give any conclusive results.

Rauwolfia canescens, was found to be similar in habit to *R. Serpentina*, but was more hardy and branched better. With regard to *Rauwolfia serpentina* experiments were carried out to find out the best time for sowing. The best sowing time proved to be the latter part of May. Even when the seeds were sown in autumn they remained dormant and sprouted in April and May. One year old plant, of *R. Serpentina*, collected from the plantation, yielded 1.294 per cent of the total alkaloid in air dried samples.

Medicinal Plant Scheme, Assam

The seeds of the following plants were received and tried :

1. *Lobellia inflata*
2. *Hemanelis virginiana*
3. *Atropa belladonna*
4. *Arnica montana*
5. *Digitalis purpurea*
6. *Chenopodium ambrosoides* Var. *Anthelminticum*
7. *Podophyllum hexandrum*
8. *Swertia chirata*
9. *Chrysanthemum cinarariaefolium*
10. *Ocimum killinandscharicum*
11. *Cassia angustifolia*
12. *Mentha piperita*

Schemes for Investigations on the Production of Ergot, Assam

In the experiment on the time of sowing, rye seeds sown in November which came to flower by the end of January or early part

of February gave best results. The percentage of germination was 95 per cent and percentage of infection was 30 per cent. The Rye varieties, Black winter and Russo, especially the former, were found to be the most promising for ergot production. The maximum number of sclerotia were produced when ear heads were sprayed after the third week of the emergence of ear head.

It was observed that ammonium sulphate and farm yard manure induced better vegetative growth and higher yields of sclerotia. It was also observed that 40 gms. of Rye seeds with 45 c.c. of water proved the best medium for promoting the growth of *Claviceps purpurea* for mass inoculation in the field.

AGRICULTURAL IMPLEMENTS

Under the Scheme for the production and trial of Japanese and other improved agricultural implements, different types of implements and machines, (e.g., Rice hand Weeder, Grain Screen machine, bullock Drawn Seed drill and Orissa plough, Pedal Operated Paddy Threshers and Olpad Threshers etc.) were supplied to various State Governments for trial.

The Survey of indigenous agricultural implements was completed in all the States except U.P., Mysore, Rajasthan and PEPSU.

In pursuance of the recommendation made by the First Conference on Agricultural Implements and Machinery, Advisory Committees on Agricultural Implements consisting of the representatives of the Agricultural Departments, farmers and manufacturing firms for testing and popularising improved agricultural implements have been constituted in the States of Bombay, Madras, U.P., Madhya Pradesh, Hyderabad and Bhopal. The Second Conference of Agricultural Engineers held in September, 1956 also reiterated the recommendation made at the last Conference that the advisory Committee on Agricultural Implements should be set up in those States where this had not yet been done.

The Council has sanctioned a scheme for the award of Prizes for making improvements in the following 15 selected agricultural implements. (1) Transplanter for paddy, (2) Groundnut digger, (3) Seed drill for graincrops, (4) Water-lift, (5) Clod Crusher, (6) Cotton Plant puller, (7) Cart Wheels and Carts, (8) Yokes and harnesses for bullocks, (8) Seed drill for maize, beans, and peas, (10) Bullock sweep power unit, (11) Bullock drawn reapers for grain crops, (12) Inter-cultural Implements for paddy and other crops, (13) Sugarcane Planter, (14) Thresher, (15) Potato Planter. The amount of prizes varies from Rs. 300/- to 100/-.

CHAPTER III—ANIMAL HUSBANDRY RESEARCH

CATTLE BREEDING

Live-stock investigation scheme—Hissar (Punjab)

The scheme started functioning at Government Livestock Farm Hissar in April, 1943 with the object of investigating the possibility of evolving a dual purpose animal by Scientific breeding and combining the two economic characters *viz.*, draught ability and milking capacity.

During the year under report 24 cows of the foundation stock and 142 of F₁ generation were mated to the selected bulls. The sex ratio of 105 calves that were born worked out to 110 males to every 100 females, as against 150 males for every 100 females calculated from the data for the last 10 years, covering 860 births. The average birth weight of calves worked out to 52.1 lb. This compared favourably with the average weight of 50.6 lb. recorded from the inception of the scheme.

A study of the milk records revealed that there was an increase in production during the past five years. A study of the lactation records from the inception of the scheme showed that 8.4 per cent cows yielded 3000 lb. and above, 26.8 per cent between 2000 to 3000 lb. 45.4 per cent. between 1000 to 2000 lb. and 19.4 per cent below 1000 lb. The yields of the 64 cows which completed lactation during the year ranged between 1489 lb. and 2752 lb. The lactation periods ranged between 256.5 days to 301.0 days. The average calving interval was recorded as 574.42 and 46.45 days as compared with 596.03 and 53.86 days during the previous year.

A study of the effect of season on fat percentage in milk based on 1603 observations indicated that the fat percentage was maximum (4.9 per cent) during winter and minimum (4.3 per cent) during summer. The morning milk on the average was richer in fat content than the evening milk. The butter fat records of 171 daughters of the experimental bulls revealed that daughters born to Bull No. 2HP 42 yielded the highest fat percentage (4.8 per cent) while the minimum (4.4%) was from bull No. 163 H 1/40.

During the year under review dam-daughter comparison and sire indices were studied from the data based on first lactation yields of 119 F₁ progeny. The sire Index of bull No. 2H. P/42 worked to only 1751-10-7177.0 lb. and was considered creditable. The index of other bulls ranged between 1000 lb. and 1540 lb.

A study of the reaction time recorded for each experimental bull revealed that on the average, the bulls took 25 minutes 26 seconds for each service. The range of the time taken for service was between 10 minutes 55 seconds and 35 minutes 25 seconds. The overall average fertility as calculated from the data collected during the last six years worked out to 53.4 per cent. The rate of fertility of the purchased bulls was recorded to be higher than that of farm bred bulls. It was further observed that the age of the bull had no influence on the number of fertile services.

During the year six positive cases of tuberculosis and one case of brucellosis were detected in the herd. In all 35 cases of infertility were examined. Of these five were treated for persistent corpus luteum, eight for cystic ovary and 21 for anoestrous ovary. One case could not be diagnosed. The mortality in the herd was 3.6 per cent as against 3.8 per cent. during the previous year.

Improvement of Kangayam Breed, Palayakottai, Madras

This scheme was started in July 1942 at the Palayakottai Farm, (Madras) with the object of improving milking qualities in Kangayam cows without adversely affecting the draught capacity of the males of the breed. The work on measurements of draught capacity continued to be handled by a Committee of Experts as in the previous year.

Selection of bulls was made by random selection, castrating every alternate animal and using it for draughtability trials. Certain difficulties were met with in pairing the selected bulls and putting them to the yoke. The animals were, therefore, paired with non-experimental bullocks of the same age and body development.

The average age of maturity (first calving) was recorded as 4 years 5 months based on 22 heifers which calved during the year. Prenatal massaging of the pregnant heifers revealed that in 75 per cent cases the yield was higher than the animals kept as control.

During the year under review 60 cows of the foundation stock and 112 of the progeny completed their lactations. The milk yield was recorded once a week both morning and evening by complete stripping of the udder. A study of lactation records revealed that 69 cows from the foundation stock and 28 from the progeny yielded 2000 lb. of milk and above in a lactation; 34 cows from the foundation stock and 73 of the progeny yielded between 1000 and 2000 lb. and 31 cows from the progeny yielded below 1000 lb. of milk. The average fat percentage in milk was recorded as 5.1 per cent for the foundation stock and 4.5 per cent for the progeny. During the year under report there were in all 39 calvings of which 45 were bull calves and 44 heifers. The average birth weight of bull calves was 46.7 lb. and that of heifers 42.2 lb. The average per day increase in weight was recorded as 0.8 lb.

Feeding was carried out on the basis of ration prescribed by the Council. However, the ratio of concentrates was changed from time to time according to the availability of grazing during various months.

Breeding bulls 45 in number were distributed from the stock to Key Village Schemes, Artificial Insemination centres and Bull Distribution Scheme. During the year under report, 729.6 artificial and 1617 natural services were given by these bulls.

Selective breeding versus grading up (Orissa)

The scheme was started at Bhanjnagar in July, 1953. The foundation stock consisted of 120 Ghumsur cows. The two groups of 60 cows each were allotted to three Harijana bulls and six Ghumsur

bulls. During the year under report there were 36 calvings, 15 females and 21 males. There were 13 abortions in the herd. Another 56 cows were found to be in calf. The animals were fed on a balanced ration and the feed consumed by them was recorded.

The average weight of Ghumsur cows was recorded as 373.1 lb. The average birth weight of the calves was recorded as 28 lb. 8 oz. in the case of Ghumsur males, and 27 lb. 15.05 oz. for Ghumsur females. The weights of graded Hariana calves were 35 lb. 9.14 oz. and 34 lb. for males and females respectively. This showed an improvement in body weight over pure Ghumsur. During the year under review four cows and six calves died of non-specific diseases. The stock was tested for contagious abortion and 50 per cent. were found to be positive reactors. The animals have been vaccinated with strain 19 and the problem was being further investigated.

Central Artificial insemination Station, Bangalore

As stated in the previous year's report the six Jersey bulls received through the U.S., T.C.M. in India were 10 to 14 months old, weighing about 500 lb. on their arrival. Monthly records of body weight were kept to study their growth. By the end of September, 1956, the bulls were trained and it was observed that on the average about 4 c. c. of semen was collected from each ejaculate. The quality of semen as judged from density, mass activity and motility was good in respect of all the bulls. The dilution of semen despatched to various centres was kept between 1/10 to 1/20 depending upon the demands. Studies on the various types of semen shippers revealed that the one designed by the Indian Veterinary Research Institute was found to be most suitable for air lifting of semen.

The actual despatch of semen for insemination work in the States was started only in October, 1955. During the period October to December 2451 c.c. Jersey and 200 c.c. of Sindhi semen were despatched to Cochin. Trivandrum, Coorg, Visakhapatnam, Ooty, and Coimbatore.

Cross breeding

As reported in the previous year, this is a co-ordinated scheme of research on cross-breeding of non-discript cattle in heavy rain-fall and hilly areas with Jersey bulls to improve their milking qualities. Artificial breeding is practised by using semen air-lifted from Central Artificial Insemination Station, Bangalore. The States of Andhra, Bihar, Madras and Travancore-Cochin had already undertaken the project, while the preliminary work relating to house-to-house survey was being conducted in Punjab, Manipur and Assam. A uniform set of proforma for maintenance of records was evolved for use at the Central Artificial Insemination Station and the State Centres.

Studies on immunogenetics of cattle, I.V.R.I.

The work on the Scheme commenced during February, 1955, at the Indian Veterinary Research Institute, with a view to study the breed differences amongst important breeds of cattle. The inheritance of cellular antigen and the effects of incompatible blood groups on the health of offsprings were also included in the programme.

The animals required for the experiment had been selected and equipment had been obtained. During the short period only preliminary work on the immunisation of cattle was started.

Physiological genetics of different breeds of Indian cattle under adverse climatic conditions

The scheme was started in October, 1954, at Haringhata with a view to find out how the animals of Hariana Gir, Tharparkar, Sahiwal and Sindhi breeds would thrive when transferred from their home tracts to the hot and humid climate of West Bengal.

There was some delay at early stages in procuring the required number of animals from the various farms. However the animals required for the experiment had now been procured and physiological observations were being recorded.

SHEEP BREEDING

Improvement of sheep and wool

The co-ordinated scheme for the improvement of sheep and wool production on a regional basis through research, carried out at a number of centres located in different regions of the country according to a planned programme, was continued.

Temperate Himalayan Region, comprising of hilly regions of U.P., Punjab, Himachal Pradesh and Kashmir.

The policy in this region is to cross breed selected indigenous stock with imported Rambouillet (Merino) rams.

Pipalkoti (U.P.) This is the main centre of the region. As only one ram was available in the beginning all the 65 Rampur-Bushier ewes were mated to this ram No. 782. However, when another ram was received from Gulamdham, 20 ewes were allotted to it. During the next mating season, it has been proposed to divide the local ewes into four groups and allot them to different rams as a sufficient number of rams would by that time become available.

Out of a total of 10 Merino and 65 Rampur-Bushier ewes mated to the ram No. 782, 14 Merino lambs and 62 Merino cross-bred lambs were born. Three Merino ewes lambed twice and there were two pairs of twins. One Rampur-Bushier ewe also lambed twice. The 20 Rampur-Bushier ewes mated to ram No. 618 gave birth to 11 lambs.

The growth records of the progeny were maintained. The average birth weights of Merino, cross-bred and Rampur-Bushier lambs were 8.7, 5.2, and 5.0 lb. respectively. The pure Merino stock was born only once a year whereas the cross-bred and the Rampur-Bushier ewes were born twice a year. The average fleece yield for the cross-bred progeny was 3 lb. 10 oz. for male and 3 lb. 4 oz. for female lambs.

During summer rains the Merino cross-bred progeny and the Rampur-Bushier stock were shifted to the mountain tops. The pure Merino stock continued to be maintained at the farms, and concentrate feed supplement was fed to the pure-bred, Merino crosses and out of condition Rampur-Bushier ewes.

The flocks were maintained in good health. The percentage of mortality was 15.5 per cent, the majority of the deaths occurring amongst Rampur-Bushier adults and Merino cross-bred lambs. The flocks were periodically dipped in 2 per cent. Gammaxene.

Wool Laboratory: During the period under review, in all 1028 wool samples from Pipalkoti and other sheep farms from U.P. were tested for medullation by Benzol method. Out of these, 47 per cent. were found to be under the Categories 'A' and 'B'.

The analysis of wool from cross-bred lambs showed a mean range of 13.22 to 25.12 microns in diameter, 32.84, to 91.51 m. m. in length and 2.66 to 18.67 in medullation.

Regional sheep breeding scheme, Kashmir

This is the second centre in the region and the object is to cross-breed indigenous types of ewes with the imported Rambouillet rams and to evolve a breed of sheep with superior wool. Five groups with a total of 193 ewes were mated to four Rambouillet rams. In all, 119 lambs were born, the lambing percentage being 81.5 for the ram K 10, the same for rams K 16, K 18 and K 19 was 100, 45.2 and 62.7 respectively. The birth weight records of lambs showed that the highest number of lambs were born in 6 lb. and 7 lb. birth weight group which accounted for 78 per cent. of the total births. The growth records of the progeny were maintained by weighing at six monthly interval. A study of the colour pattern of the lambs had been made and the data collected would be statistically analysed.

In all 44 half-bred Ram buiullet rams were mated with the selected farm-born ram No. K 15. As a result of this mating, 21 lambs were born in this group giving a lambing percentage of 47.7. Of these, 11 belonged to 7 lb., and 8 lb., birth weight groups, showing an overall increase in birth weights of progeny.

An analysis of the fleece of 126 half-bred Rambouillet progeny showed that there was a uniform decrease in the diameter and medullation percentage of the progeny. It was also observed that there was a steady increase in the scouring loss in the progeny. The density of wool fibre showed an increase of 70 to 140 per cent. The fibre weight also increased by 4.7 per cent.

Breeding of Australian blood lines

As stated in the last year's report, the 169 ewes left over from the old scheme had been divided into groups A and B, according to the fleece quality. Group A possesses wool quality of 58s and above, and the group B possesses wool quality of 56s and lower. The first group comprised of 95 ewes which attained Merino standard in wool quality and body characteristics. These were being interbred to three selected rams from the same group possessing the same standard of fleece quality.

The 74 ewes in the group B were mated to the Delaine Merino imported from America. By the continuous introduction of Merino blood it is desired to eliminate the group B and to bring about a

flock of the standard presently attained by group A. The flock forms the nucleus for the development of the future Kashmire Merino. A total of 70 lambs were borne to group A and 56 to group B giving lambing percentage 83.3 and 75.6 respectively. The colour pattern of the progeny accounted for 82.8 per cent. of white lambs.

In all 370081 vaccinations and mass treatments were given to control the incidence of diseases. There were only two cases of anthrax which was prevalent in the Kishmir flocks in the past. A total of 1362 animals were dipped with arsenical Copper's dip. Another 1362 animals were dosed with carbon tetra-chloride and 3482 with copper sulphate solution. Phenothiazene was also used for de-worming 310 animals.

Improved types of shearing blades, manufactured locally, gave good results when tried on the flocks. The effect of the number of shearing on the yield of wool for a year was also studied. The Wool utilisation centre could not be established and the wool produced at the farm was supplied to the Industries Department where from no adverse report had been received. During the year under review, in all, 173 rams were issued for sheep development work. Of these, 12 were handed over to the U.P. Government and the others were issued for being kept among the village flocks or for breeding purposes at the Animal Husbandry Units in the States.

Himachal Pradesh (Sarhan)

This is the third Centre in the Himalayan region. The site for the farm has been acquired and the work would be started shortly.

Southern Region

The main centre of this Region is situated at Poona, Bombay. The object of the scheme is to evolve new strains of sheep carrying superior fleeces suited to the Deccan plateau and to maintain the data relating to wool quality inherited in successive generations. The scheme also involves the supply of breeding stock of the rural areas and to study important problems of sheep husbandry including nutrition. The programme includes the selective breeding of the Decani sheep and cross-breeding them with the Merino and inter-breeding of different grades.

Selective breeding

During the year, out of the 46 ewes in the flock, 36 lambed giving birth to 11 ram lambs and 20 ewes. The study of the percentage of medulated fibres of dams and the progeny indicated that there was no significant improvement caused in the progeny of the ram under trial. The change in the diameter of the fibre was also not significant, the fibre density did not increase. Thus the ram number 820 which was used on the flock did not bring about improvement as far as these attributes were concerned. However, the wool quality of the progeny showed an increase in homogeneity. It is proposed to discontinue the ram and use the two sons of a proven sire. The wool clips were graded according to the fineness of their fibre. The spinning quality ranged from 36s to 50s.

Cross-breedings

The fleece of three generations of cross-breeding of the Decani ewes towards Merino were studied. It was observed that the number of medullated fibres and the diameter of fibres decreased with the increase in the percentage of Merino blood. The study of interbreeding of cross-bred Merino showed an improvement in the fleece from 48s to 60s. Breeding of 5/8 Merino with quarter-bred ewes also showed an improvement of wool quality from 36s to 58s. Back-crossing of 3/4th Merino rams to Decani ewes brought about improvement in the spinning quality from 30s in the rams to 62s in the progeny. The progeny of Rambouillet rams mated to the Decani ewes showed an improvement in the quality of wool and the density of the fibre.

Wool laboratory

During the year under review 8717 samples of wool were analysed. Of the samples received from other States it was observed that the finest wool was received from the Sheep Breeding Farm, Kashmir.

Of the 107 samples received from Himachal Pradesh it was observed that 95 per cent. of the local sheep had a quality of 50s. A study of correlation of tensile strength and other attributes of wool fibre showed that it was necessary to test 465 samples for obtaining 5 per cent. error in case all the fibres were taken together for testing, without classifying them as fine and coarse. There was no advantage in taking a composite sample. However it was found necessary to analyse a number of samples obtained from separate body regions of different animals before a final conclusion could be drawn.

A study of the fleece density of 28 farm-born lambs, taken at different age intervals revealed that the variation in fleece density was highly significant. There was a difference from animal to animal. Similarly the change in fleece density amongst different age groups from the age of two months to 10 months was significant. The fleece density was on the average 1505 fibres per square centimetre during the first period and it gradually decreased to 776 fibres per square centimetre during the fifth period. Studies were also carried out on the correlation between fibre diameter and the percentage of medullated fibres. It was observed that an increase in fibre diameter was accompanied by an increase in the percentage of medullated fibre.

Exploratory work on the estimation of colour in wool samples was conducted to decide grades for the export trade. The grading of local and Decani goats to pure Angora buck was continued at the centre and it was observed that the fleece produced by the three-fourth Angora progeny was far superior to the pure Angora fleece.

Trial with village flock

In all 150 flocks with a population of 750 sheep in which rams from Government farm were placed, were subjected to breeding trials. A study of the fleece quality of the sheep in the 34 flocks was undertaken to estimate the improvement brought about by the

rams issued by the Government Farms. It was observed that there was a decrease in the medullated fibres and the fibre diameter of the progeny as compared with their dams.

Utilisation of wool

The centre is equipped with an experimental wool utilisation unit and it was possible to meet the demand of co-operative institutions for the processed silvers and yarn. Small samples of fabrics were also manufactured from the different types of wools produced in the Deccan and it was observed that the fabrics thus manufactured compared well with the Scottish Harrish tweeds as regards the feel and quality.

Madras State (Nilgiris)

The object of the Centre is to carry out selective breeding amongst Nilgiri sheep. During the period 190 ewes were mated to seven selected rams and 66 lambs were born. Wool analyses of the foundation stock and progeny could not be carried out due to lack of laboratory facilities.

Eastern Region (Gaya)

The scheme was started in late 53 with the object of testing the adaptability of Romney Marsh and Gaddi breeds to the local climatic conditions. It was also decided to up-grade the Chota-Nagpur sheep with the Romney Marsh and Gaddi rams to evolve a better type of sheep.

The flock has been purchased and Gaddi rams procured and, as a preliminary step, 312 samples of wool taken from 69 Chota Nagpur sheep were analysed.

Wool analysis laboratory (Gaya)

During the year under review 312 samples, taken from 68 sheep, were analysed for medullation percentage, diameter and length measurements. It was observed that the Chota Nagpur sheep had an average medullation percentage of 34.9 average diameter of 47.6 microns and average staple length of 32.3 m. m.

A study of the various types of fibres and their distribution on different parts of the body of Chota Nagpur sheep revealed that the wool from three regions, viz., neck, withers and shoulders could be classed as one type, as it did not significantly differ in quality; as such, this part of the fleece could be clipped together and bulked separately for marketing. A study of the fleece density and grease contents in relation to fineness carried out on 25 ewes revealed that the average density worked out to 3712 per square inch for the particular season but with the data available at present relationships between these attributes could not be established.

Dry northern region, Joria (Bombay)

The scheme is working since December, 1953 as a part of the regional plan. The object is to evolve a new breed of sheep which will yield non-hair fleece with a uniform staple which could be

utilized for the manufacture of clothing and high grade carpets. The programme includes selective breeding of Patanwadi and Kutchi sheep.

Under the Patanwadi group 104 ewes were divided on the basis of fineness of fleece and allotted to four selected rams.

During the period 83 ewes were mated and out of these 80 lambs were obtained; two ewes aborted and two ewes gave birth to twins. A study of the percentage of medullation revealed that out of the 104 of the foundation stock 14 ewes had no medullation, and taken as a flock, the percentage of medullation varied from 0 to 36 per cent. Studies for the existence of medullation amongst the five-month old progeny were also made, but no comparative study could be taken up at this stage. The primary work indicated that there was a possibility of evolving a woolly sheep by selective breeding. It was further observed that the diameter of the fibres decreased in the progeny as compared to their rams. There was also a slight increase in the fleece density of the progeny over their dams. The selective breeding of the Cutchi sheep could not be undertaken. All the lambs born were weighed at birth and their growth was recorded at weekly intervals. The average birth weight of ram lambs was 6.8 lb., and that of ewe lambs 7 lb. There was no difference in the rate of growth in the different groups and sexes.

During the year under review eight ewes of the breeding stock were selected at random to study the variability of the fleece density between the different regions of the body. It was observed that there were 936 fibres per square centimetre in the shoulder region, 720 in the britch, 920 in the neck, 911 on the wither, 834 on the side and 936 on the back. It was observed that the fleece density was significantly lower in the britch region than the other parts of the body. A study of the inter-relation between the different attributes of wool quality revealed that there was no significant association between the fleece density and the diameter.

There was also no association between the fleece density and the percentage of the medullation. Thus the selection of animals could not be made on the basis of fleece density alone. Further, a positive co-relation was observed between the fibre diameter and the percentage of medullated fibre. The selection of animals could therefore be made on the basis of one of these attributes.

Rajasthan. The work at this centre envisages selective breeding of Bikaneri sheep. Preliminary work in establishing the research station has been carried out.

Sheep Research Section Government Farm, Hissar

The centre was established in 1953 with the object of improving Bikaneri sheep and their wool under range conditions, conducting fundamental research and standardising methods for the measurement of various characters of sheep and wool. During the year under review the flock maintained a healthy condition. As reported in the previous year the flock was maintained in two groups, A and B, according to their wool quality. The percentage of conception was 72.2 in flock and 70.5 in flock B. The fleece from 115

females was put to benzol test. It was observed that 50.4 per cent. came under group A with an approximate medullation of 0 to 20 per cent. Another 24.3 per cent were classified under group B with a medullation of 20 to 40 per cent., 24.4 per cent. were in group C with 40 to 60 per cent. medullation and 0.9 came under group D with medullation above 70 per cent. Of the 137 males tested 54.7 per cent. were in group A, 28.5 per cent. in B, 16.8 per cent. in group C and nil in group D. In order to fix standard for scores for fleece covering, 149 female lambs were selected for study and were given a score for the covering of fleece on the face and head. Scores will again be allotted to these lambs at the time of subsequent shearings to study the persistence of this character.

In all, 130 female lambs and 20 male lambs were given scores for the standardisation of body types.

Measurements and body characters were also recorded. A new method to assess the medullation was evolved. A study of fleece density, with the help of Wydena callipers, from the different regions of the body revealed that there was a wide range of difference in the density of duplicate samples from each region. It was also apparent that the variation was the least between duplicate samples from the side and back regions. In order to compare suitability of one of the two sides, 80 samples were analysed. To study the canary colour in wool, suitable samples with all variations in colour were collected and a colorimeter was set up because yellow colour in various concentrations did not serve the purpose. No progeny tests could be conducted as the standardisation of measurements of clean fleece was still under study. The work on washing, shearing and classification of wool and the effect of dipping on its quality was continued.

During the year under review, liver infections were the cause of a fourth of total mortalities. The problem needed special investigation. Routine dosing of 2 per cent., for de-worming was continued.

Post-Graduate course in sheep and wool (Hissar)

In all, eight students from different States joined the course which lasted for 11 months. Each student was assigned two review papers and one problem, apart from lectures and reading assignments.

GOAT BREEDING

Goat Improvement scheme (Travancore-Cochin)

The scheme was started in the year, 1951, with the object of carrying out selective breeding of Malabar goats, and to distribute the progeny tested bucks for improving goats in the States. Feeding experiments to determine the economic ration for milk production were also included in the programme.

During the year under report all the 231 does were allotted to four selected bucks. In all, there were 173 kiddings and 14 abortions. The percentage of fertility was 81. The average birth weights of kids were recorded as 5 lb. 10 oz. for males and 4 lb. 15 oz.

for females. The average kidding interval for the year worked out to 269 days as against 280 days in the previous year. The age at first kidding for 51 F₁ generation does was recorded as 1 year 6 months and 27 days.

The principal diseases met with among the kids and in the flock were pneumonia, aptha, joint-ill and white scours.

During the year under report 115 goats completed their lactations. The average milk yield in a lactation was recorded as 144 lb. 5 oz. The highest yield recorded during the year was from the nanny No. 18 which gave 257 lb. 14 oz. of milk in 210 days. The average lactation period calculated for the year worked out to 146 days. The dry period came to 123 days.

Indigenous Goat Breeding Scheme (Punjab)

The scheme for selective breeding of the Betal goats with the object of increasing the milk yield was taken up at the Hissar Farm in October, 1939. Along with carrying out the breeding programme the economic factors relating to the rearing of these goats were also to be investigated. The stock was regrouped in the year 1951 into six families and each family was allotted to a selected buck.

During the year under report 68 does of the foundation stock and 47 of the F₁ and F₂ generations were mated to the selected bucks. The maximum services were recorded during June and August. In all there were 64 normal kiddings comprising 16 singles, 36 twins, 10 triplets and 21 quadruples; 39 does from the F₁ and F₂ stock also kidded. The average age at first kidding was recorded as 728 days as against 837 for the previous year. The sex ratio of kids as calculated from the records of the previous 15 years comprising 3559 births worked out to 105 males for every 100 females. The average kidding interval during the year was recorded as 343 days as against 332 days in the previous year.

In all 144 goats including 19 from the F₁ generation completed their lactations during the year under report. The average milk yield in a lactation was recorded as 442 lb. The highest yield was 1303 lb. 10 oz. in 602 days lactation. A study of the frequency distribution of lactation yields revealed that 21.2 per cent. of the goats were in 301 to 400 lb. group. From the study of yields of different lactations; it was observed that the peak production was achieved during the fifth lactation and thereafter the yield gradually dropped. After the seventh lactation the drop was significant. The maintenance of goats during the eighth lactation and subsequently was therefore considered uneconomical. The average number of milking and the dry period during the year was 207 and 116 days respectively.

A study of the fat percentage in milk during different seasons revealed that it was 5 per cent. in winter and 4.4 per cent. during summer. The fat percentage of evening milk was higher than that of the morning milk.

Experiments on the rearing of goats under different systems were continued. The data collected during the year under report confirmed the findings of the previous year that grazing alone and

grazing plus stall feeding were profitable bringing in an annual net saving of Rs. 250 and Rs. 67 respectively as compared to stall feeding which resulted in a loss amounting to Rs. 203. However, the goats under the stall feeding and stall feeding plus grazing groups showed better performance at the pail.

The average birth weights of the kids born during the year were 6 lb. 7 oz. for 159 males and 6 lb. 1 oz. for 144 female kids. A study of weekly growth revealed that the male kids grew faster than the female kids.

A study of mortality amongst kids born in different seasons revealed that the best season for kidding was in July to October. The effect of this kidding season on lactation, dry period and calving interval was under further study.

During the year five goats proved positive for T. B. There were 24 cases of abortion, but all these animals gave negative results to the laboratory tests; 25 fresh cases of mastitis were detected and treated with antibiotics. The mortality recorded in the flock was 14.7 per cent. amongst adult, 32.9 per cent. amongst young stock and 22.4 per cent. amongst the kids under one month.

Angora Goat Breeding Scheme, U.P.

The scheme started in the year 1950 at Pippalkoti, with the object of evolving mohair yielding strain of goat by crossing the local white hairy goats to the imported Angora bucks. It was also envisaged that the local goat stock in the village was to be improved by introducing the Angora breed. The herd is now shifted to Gwaldam (Garhwal) as there was a shortage of grazing at Pippalkoti.

During the year under report, the climatic conditions were favourable from April to June, but during the month of March high humidity, cold, rain and scanty grazing adversely affected the health of the herd. These conditions brought about a set-back to the crop of kids.

The herd of the local and the graded does was divided into four groups and each was mated to an Angora Buck. The kidding during the years was not encouraging. This is attributed to the old age of the foundation stock of nanny goats. The average body weights of kids at birth were recorded as 4.7 lb. for the bred Angora and 5.2, 6.5, 5.2 and 5.1 lb. respectively for F₁, F₂, F₃, F₄ graded progeny.

The appropriate age for the first mating was considered as 10 months. This information could not be considered as final as it was based on scanty records. One F₂ doe number A 442, however, kidded very early; her age at the time was 11 months and 25 days.

The entire stock was vaccinated against Rinderpest and haemorrhagic septicaemia and helminthic infection in the stock was controlled by the use of phenothiazine, copper sulphate and haxachlorethane.

The study of the effect of dipping and washing on the quality of mohair revealed that dipping did not affect the quality, but washing of fleece was not desirable. The average fleece yielded during

the September, shearing was 4.5 lb. for the pure-bred Angora bucks, and 3.9 lb. for the Angora does, the same for F₂ goats was 1.7 lb. During the March Shearing, the average yield from the pure-bred Angora bucks and does was 2.4 and 3.2 lb. respectively. The yield for this shearing from F₂ goats was recorded as 1.2 lb. The fleeces were taken over by the Department of Cottage Industries. The hair obtained from F₁ and F₂ grade herd was extremely popular with the local spinners.

POULTRY BREEDING

Poultry Development Scheme (Travancore-Cochin)

The scheme was started in 1952 with the object of studying the suitability of White Leghorn and Rhode Island Red breeds of poultry in heavy rainfall and humid areas. It was further proposed to bring about poultry development by grading up the local flocks with these exotic breeds. During the year under report, it was observed that highest percentage of hatchability was achieved in both the breeds during July and August. The hatchability was lowest during September and February in the case of White Leghorn, and January and February in the case of Rhode Island Red. However, the seasonal variation in hatchability was not significant. The average weight at hatch of white Leghorn chicks was 1 oz. 6.9 drs. whereas that of Rhode Island Red was 1 oz. 3.7 drs. The weight at 24 weeks was 3 lb. 10 oz. 14.8 drs. for White Leghorn and 4 lb. 6 oz. for Rhode Island Red. The average age at maturity in the case of White Leghorn was 163.7 days and the same for Rhode Island Red was 218.4 days. The data on the number of eggs produced and their sizes for full pullet years were not available. The work of this item would be continued in the next year. Work on the grading up of *desi* fowls was undertaken by distributing 54 White Leghorn cocks in Puthur Panchayath and 86 Rhode Island Red cocks in Vyapeen Island.

Influence of climate on the performance of Desi birds (Orissa)

The scheme was started in January, 1953, with a view to study the performance of the improved strain of *desi* fowl developed by the I. V. R. I. under different conditions of soil and climate. Fifty pullets were selected during September, 1954 for trap-nesting and recording egg yields and egg weights. During the year under report the average egg production was recorded as 144.22 and the average weight of egg as 1.55 oz. The data on the persistency in production was not sufficient to draw conclusions. Of the 50 selected pullets nine attained maturity between 150 and 180 days, 18 between 181 and 210 days, 12 between 211 to 240 days and 11 matured after 240 days and above. It was further observed that the pullets which attained early maturity on the average gave a higher egg production. During the period under review only 10 birds became broody. The maximum average weight of 3.96 lb. was achieved during December, 1954 when most of the birds were 11 months old. Probably this was considered as the age of physical maturity.

The birds were grouped according to their phenotypical characters and their physical appearance was related to the egg production records. It was observed that mottled and partridge types gave the highest egg production. The number of births of

birds with dark legs was also higher than that of birds with yellow legs.

Poultry Development Research Scheme (Madhya Pradesh)

The scheme has been in operation for the last ten years in Madhya Pradesh. The object of the scheme is to collect and study the data on the production of various generations of *Desi* birds along with identical studies on Rhode Island and Red and White Leghorns. Intensive work on poultry development in selected villages was also envisaged in the scheme.

During the year under report, 24 different graded and *Desi* pullets were available for study of laying records. It was observed that the fifth grade White Leghorns and Rhode Islands Reds and corresponding *desi* birds matured the earliest. The average age at maturity of fifth grade Rhode Island and Red White Leghorns, and *desi* birds was recorded as 289.2, 277.1 and 248.2 days respectively. A dam daughter comparison with regard to age at maturity revealed that except for White Leghorn and Rhode Island Red sixth generation daughter, all the daughters matured later than their dams.

The overall laying-house-mortality was calculated at 22.7 per cent. as compared to 23.9 per cent. of the previous year. A comparative study of laying-house-mortality in the fifth and sixth generations, White Leghorn and Rhode Island Red revealed that the mortality was lower amongst daughters than dams.

A generation-wise study of egg production during the year revealed that the inter-crossed seventh generation daughters, White Leghorns laid the largest number of eggs. In comparison, the eighth generation of up-graded White Leghorns coming from the same dams laid 61.74 eggs. This is in conformity with the results recorded last year with the sixth generation birds.

A statistical study of the data on egg weights revealed that there was highly significant difference in egg weights from different grades and *desi* birds. The heaviest eggs weighing on the average 1.8183 oz. per egg were laid by the eighth generation Rhode Island Red and the lowest average weight of 1.2257 oz. was recorded in the eighth generation *desi* birds. A comparison of egg yields from early and late maturity types showed that daughters from early maturing dams recorded higher egg production than those from the late maturing ones.

The study of egg weights of different generations showed that except for the second generation White Leghorns and Rhode Island Reds, the egg weights of the succeeding generation increased gradually and the *desi* birds had a smaller egg size than the grades. No difference was however observed in the egg sizes of different generations of *desi* birds. The egg weight from the seven generation Rhode Island Red was recorded as 1.84 oz. as against 1.883 for the sixth generation Rhode Island Red.

In a study of the egg production, the various generations during the entire period revealed that the fifth generation birds gave the

highest production. This was followed by a decrease in the number of eggs in successive generations. The maximum egg production amongst *desi* birds was achieved in the fourth year.

A study of chick mortality amongst various grades revealed that the third and the eighth grade Rhode Island Reds had the least mortality. The mortality figures for different grades differed significantly. The percentage of mortality amongst the eighth generation Rhode Island Red was 52.55 and the eighth generation *desi* birds 55.48 against 77.82 for the second generation inter-breds of Rhode Island Red and 73.2 for second generation inter-breds White Leghorns. The overall mortality for White Leghorns of Rhode Island Red and *desi* grades was 73.1, 65.8 and 55.48 respectively.

A study of the data on the cost of feeding in the rural units at Mansar revealed that feed consumption per bird was 4 lb. per month. The cost of the feed amounted to five annas per bird per month for White Leghorn grades. The cost of feeding per bird per month at Keljhar was eight and a half annas. A comparison between the cost of feeding per bird per year at the above two centres with that at Nagpur revealed that it was Rs. 1-10 less at Mansar and Rs. 3-13-3 less at Keljhar.

Studies on the preservation of eggs in lime water were continued. It was observed that eggs could be preserved in saturated lime-water solution up to 30 days.

To carry out development work in the villages of Mansar and Keljhar, 90 White Leghorn and 89 Rhode Island Red cocks were introduced in the flocks at these two villages.

ANIMAL NUTRITION

Nutritive values of grasses and leafy fodders

The scheme to determine the nutritive value of certain indigenous grasses and leafy fodders continued to function at the I. V. R. I. During the year under report, the nutritive value of six species of leafy fodder, viz. *siras* (*Albezzia lebbeck*) *Mahua*, (*Bassia latifolia*) *bel* (*Aegle marmelos*) *lassora* (*Cordia obliqua*) *sainjana* (*Moringa oleifera*) has been determined. The results indicated that *siras* leaves appeared to be palatable and nutritious, but in view of the negative balance for phosphorus, their feeding must be supplemented by phosphorus rich feeds. In case of *mahua* leaves however, as their crude protein content was nil, they could be used only as roughage to meet part of the energy requirement of sheep. A positive balance was exhibited with regard to nitrogen, calcium and phosphorus in leaves and observations of their feeding experiment showed that they were nutritious and could meet the maintenance requirements of sheep. Feeding experiments of *lassora* leaves indicated that their leaves were not palatable and in view of the deficiency of nitrogen, calcium and phosphorus they could not constitute a maintenance ration even when mixed with linseed cake and *bhoosa*. Feeding sheep with *sainjana* leaves mixed feed revealed that they developed diarrhoea and loss of weight, due to the succulent nature of the leaves and low dry matter. It appeared advisable therefore to supplement the leaves with some dry, low protein roughage during feeding.

Trace elements scheme, I. V. R. I.

The scheme to investigate the influence of trace elements on the health and productive capacity of livestock in India continued functioning during the year at the I. V. R. I. The object of the scheme is to mark out areas where trace element deficiencies in livestock occur, and to analyse fodders and the body tissues collected from diseased animals with respect to their trace element contents.

During the year under report, analyses of the feeds from various places showed that the copper intake of animals in Nilgaun (Sitapur), Jhansi (U. P.) and Hissar (Punjab) were sub-normal while those at Karnal (Punjab) were just sufficient. The data collected point out that there was widespread copper deficiency in animal feeds in various parts of India which need correction by mineral supplement. From the examination of feeds in the regions of Jalaun (U. P.), Jhansi (U. P.) Hissar (Punjab), Alwar (Rajasthan), Karnal (Punjab) and Haringhatta (West Bengal) it was seen that no manganese deficiency existed in these regions. To find out the existence of copper deficiency, blood from 30 calves in West Bengal were examined which revealed sub-acute copper deficiency. Estimation of copper in liver samples collected from slaughter houses at Calcutta, Kangra, Chandigarh, and Karnal revealed that sheep liver had normal values of copper and those of goats and buffaloes of all places except Chandigarh showed subnormal values. The haemoglobin content of blood of calves at the farms at Karnal, Chandigarh, Kangra, Jhansi, Dehra Dun and Rajasthan, Nagpur, and the farms in Madras and Bombay States was estimated and was found to be on the low side. Work in the study of Goitre in Sheep and goats was in progress.

Further work on paddy straw

The scheme to study the nutritive value of paddy straw continued to function at the I. V. R. I. and at the field units in Kangra and Assam. Preliminary tests for the estimation of potassium were divided.

Degeneration of cattle in humid climate

Work under the scheme to study the effects of humid climate on *Haryana* and Bengal cattle which was started last year was continued during the year under report.

Haryana heifers fed on Punjab and Bengal diets at Calcutta and on Punjab diets at Hissar had shown very little difference in the rate of increase of body weight.

Work was taken up to observe the effect of Bengal diet on eight Bengal type and eight *Haryana* type of animals and that of Punjab diet on eight Bengal type and eight *Haryana* type of animals. It was found that *Haryana* Buffaloes fed on both types of feed consumed less dry matter than the Bengal heifers. The consumption of water was the lowest in *Haryana* heifers on Punjab diet, intermediate in *Haryana* heifers on Bengal diet, and Bengal heifers on Punjab diet, and highest in Bengal heifers on Bengal diet. Blood serum analyses for calcium, protein and non-protein nitrogens of the groups revealed that the level of these constituents was high in

case of Haryana heifers at Hissar, intermediate for Haryana heifers at Calcutta. The group on Punjab diet had a higher value in those constituents than those on Bengal diet.

Regional Animal Nutrition Centres

In pursuance of the Council's policy for regionalisation of the research, a regional Animal Nutrition Centre for Western region was opened at Anand in 1952, a southern regional centre at Bangalore in March, 1954 and an eastern regional centre at Haringhatta in September, 1954 to study the problems of animal nutrition pertaining to each region.

Western Regional Station, Anand

During the period under report, analysis of different common straws to study the variation in their composition at different stages of maturity was undertaken. Grasses from Kutch and Palghar were also analysed. Eleven digestibility trials with common green and dry fodders were carried out. The composition of *bajri*, wheat and *Jowar* straw of last year, as compared with that of the corresponding straws of this year indicated that the former were more nutritive than the latter. A preliminary study of the composition of *bajri*, paddy, kodra, bawto and wheat straws harvested at different stages of maturity indicated that delaying the harvest of the crops by two weeks did not alter the composition appreciably. Of the 17 grasses under trial at this centre, *Desnudos uncinatum* and Phool seem to be the most nutritive. The results of digestibility experiments indicated that amongst dry fodders, *bajri* and *kodra* straws were comparatively less digestible. Amongst the three forms of *jowar* fodder, namely green *kadbi* and silage, the silage was the least digestible. Comparing the digestibility of Guinea grass and green oat, it was found that the latter was the better of the two. Between lucrae and berseem the latter was found to be better digested than the former.

Southern Regional station, Bangalore

This regional station started functioning from 1954. An animal nutritional survey was started in Travancore-Cochin State, and samples of the natural grasses and green fodder in this region and the feeds from the Government farms at Trivandrum and Malabar and Ootacamund were analysed.

Eastern Regional Centre, Haringhatta, West Bengal

The work under this centre was started in September, 1954. Analyses of the cultivated grasses at the livestock breeding station, Haringhatta, were taken up during the year. A total of 127 samples of berseem, 28 samples of gram and 36 samples of Para grass were analysed during the year. Digestibility experiment of Para grass showed that it provided a roughage of low quality and would serve only as a maintenance ration for dairy cows.

Besides the above, work under the schemes for the utilisation of waste products as cattle feed, and finding out the physiological norms of Indian Cattle were in progress in Orissa and West Bengal States respectively.

DISEASE CONTROL

Schemes for the investigation of diseases affecting livestock and poultry continued to function, under the auspices of the I. C. A. R., at the I. V. R. I. and in the States. As usual, the progress reports and technical programmes of these schemes were scrutinised and co-ordinated in the Council.

Foot-and-Mouth disease

The scheme for developing a suitable vaccine for the control of this disease continued to function at the I. V. R. I. Nine specimens of foot-and-mouth disease material received from the field were examined. The virus could be detected in only three of them, of these one proved to be type 'A'. Thus of the 76 Indian field strains so far isolated from natural outbreaks, 28 have been typed as Vallee 'O', 16 as 'O' variant; 6 as Vallee 'A', 16 as 'A' variant; 2 as Waldmann 'C', 5 as 'C' variant; and 3 as atypical strains. The three atypical strains maintained at the institute were found to preserve their characters even after 71, 22 and 17 guinea-pig passages respectively. Similarly, the type strains ('O', 'A' and 'C') obtained from Pirbright have maintained their original pathogenic and immunologic characters even after 98, 120 and 118 guinea-pig passages respectively. The natural goat strain, type 'O', was further passaged and the strain provoked more severe reaction in hill bulls than the goat-passaged strain.

Immunity tests conducted on the animals vaccinated in the field with concentrated crystal violet vaccine (bivalent, type 'O' and 'A') revealed evidence of immunity up to $10\frac{1}{2}$ months after vaccination. Earlier, in controlled laboratory trials, this vaccine was found adequate even $1\frac{1}{2}$ months after vaccination.

In a trial in thirty-two hills bulls vaccinated with Belin's vaccine received from France and said to be prepared by infecting the cattle over the body surface with a mixture of the viruses of foot-and-mouth disease and vaccinating the immunity produced was not found adequate even $1\frac{1}{2}$ months after vaccination.

Laboratory trials in guinea pigs with Papagen R 5A and Papagen R 5B (German Preparations) proved that these did not possess any curative or prophylactic value. Similarly *anavirus antiaphthous*, a metabolic product obtained from Paris did not produce any curative or prophylactic effect in guinea pigs.

Mastitis

The co-ordinated scheme for the investigation of bovine mastitis continued to function in Mysore, Bombay and Punjab and in the Indian Veterinary Research Institute. The objects of the scheme were to determine by diagnostic methods the extent of the prevalence of the disease, to find out the relative importance of different organisms involved in the causation of the disease, and to assess the efficacy of the various chemotherapeutic agents.

For determining the degree of agreement between the cultural methods and the more reliable indirect tests for diagnosis of the disease, 105 specimens of milk from 27 non-clinical cases were examined at I. V. R. I. The leucocytic count methods detected 86 per

cent. of the cases as compared to the cultural test but the 'Hotis' test picked up only 67.6 per cent. cases, the chloride test 76.2 per cent. and the Whiteside test 71.4 per cent. Work was continued to study the incidence and etiology of the disease in the farms. During the year, milk specimens from 165 cows and 29 buffaloes were studied and the following organisms were isolated:

<i>Streptococcus agalactiae</i>	10	cows
„ <i>dysgalactiae</i>	13	„
„ <i>uberis</i>	4	„
<i>Staphylococcus aureus</i>	38	„
Mixed infection	28	„
Organisms of <i>Sacchryomyces</i> groups	2	„

Out of the eight latent cases of *Str. agalactiae* mastitis treated with procaine penicillin G, seven responded to treatment. Eight clinical cases of *Staph. aureus* mastitis were treated with intra muscular injections, repeated four times at intervals of 24 hours, with a mixture of procaine penicillin, dihydro-streptomycin, sodium sulphamezathine (33 1/3 per cent.) and cobalt sulphate; of these six responded to the treatment. Also cured with this mixture were two latent cases of *Str. agalactiae* infection. Five latent cases of mastitis caused by *Staph. aureus* were treated with nitrofurazone, 2 per cent. cream, and examination after one month revealed that only two were cured.

In Mysore State cows of draught breeds like Halikar and Amrit Mahal, were observed to be less prone to mastitis than cows of milch breeds, like Sindhis and cross-bred cows. The incidence also increased with age, i.e. from 14.5 per cent. between 4-5 years of age to 34.4 per cent. in cows of eight years of age and above. The incidence was found more during the early part of lactation. Many udders affected with mastitis showed wounds, abrasions, and other injuries to the teats.

Out of the 186 positive cases of mastitis investigated, 106 were due to Staphylococci, 62 to Streptococci, and 12 to *E. coli*.

Of the various indirect tests used for detecting the incidence of the disease, the leucocytic count test was found to be the best, as it gave only 3.1 per cent. false positive results as checked by cultural examination.

An interesting case of acute mastitis in a cow, caused by a yeast-like organism, was encountered. The organism was detected microscopically and also recovered culturally. It was pathogenic for mice, and the disease was reproduced on experimental infestation in a goat.

In Bombay State bacteriological examination of 1,287 specimens of milk from 104 quarters revealed the presence of Streptococci in 99, Staphylococci in 9, and *C. pyogenes* in 2. Treatment with protagan and penicillin was found to be efficacious in cases of mixed infection due to Streptococci and Staphylococci.

In Punjab, 615 specimens of milk were examined culturally, which revealed 241 positive cases. Among the 271 cultures of mastitis-producing organisms, 157 were Staphylococci, 108 Streptococci,

4 *C. pyogenes* and one *E. coli*. Considering these results along with those of the previous two years, it was seen that staphylococci were responsible for 57.17 per cent. of the case of mastitis and streptococci for 40.73 per cent. 'Udolac' paste with penicillin introduced through the test canal cured most of the cases infected with Staphylococci and Streptococci, but not with *C. pyogenes*. Columbus medicated teat plugs, tried in cases of stenosis of teat canal, did not prove useful.

Mastitis in goats

Out of the 42 specimens of milk collected from clinically affected quarters in goats in Punjab, Staphylococci were found in 31, Streptococci in 8, and mixed infection due to *Staph. aureus* and *C. pyogenes* in one. The results so far obtained show that nearly 8 per cent. of all cases of mastitis in goats were caused by Staphylococci and about 20 per cent. by Streptococci, the incidence of *C. pyogenes* mastitis being negligible.

Tuberculosis and Johne's disease

Comprehensive investigations on the incidence of animal tuberculosis and Johne's disease, with a view to devising ways and means of diagnosis and control of these diseases, was the object of the scheme which continued to function at I. V. R. I. During the year under report, 302 cattle and 8 sheep were tested with Heat Concentrated Synthetic Medium Tuberculin at the I. V. R. I. and Kalimpong, out of which 12 proved positive or doubtful. The test was also applied to 1757 bovines in military dairy farms located in different regions, and the incidence of infection was found to be 2.84 per cent.

To study whether P. P. D. tuberculin gave any special advantage over H. C. S. M. tuberculin, 118 cattle were subjected simultaneously to single and double intradermal injections of H. C. S. M. tuberculin and single intradermal injection of P. P. D. tuberculin. A large number of animals would have to be so tested before any conclusive results could be obtained.

Six cultures of *M. tuberculosis* isolated from extrapulmonary cases of the disease in human beings were found to conform to the human type.

Bacteriostatic effect on *M. tuberculosis* of 34 compounds recently synthesised in India was experimentally studied *in vitro*. Out of these only 4'-Butyro-4-aminodiphenyl was found to be as effective as para-aminosalicylic acid and isoniazin-hydrazide.

Johne's disease

Tests were conducted on 2,066 cattle and 8 sheep at the I. V. R. I. and in certain military dairy farms by the double-intradermal johnin test, but none proved positive. Work on the preparation and standardisation of johnin and P. P. D. (of johnin) was taken up. From the studies carried out so far it appears that D. I. D. test using heat concentrated synthetic medium johnin is fairly reliable for the detection of Johne's disease. Trials on vaccination with vole strain of acid-fast bacilli strain LV 285, in doses of 2 mg. given

subcutaneously revealed that no protection was afforded against infection by John's bacilli given either orally or by intravenous route. It was also established that there was no cross-allergy between *M. paratuberculosis* and the vole bacillus. The bactericidal effect of cryosulphone and promin on *M. paratuberculosis* was also studied and it was found that promin killed a culture of *M. paratuberculosis* at a concentration of 1:2000 after exposure for 36 hours, whereas no effect was noticed with cryosulphone in this concentration and with an exposure of 48 hours.

Diseases caused by anearobes

The scheme for the investigation of diseases caused by anearobes continued to function at the I. V. R. I. During the year under report *Clostridium chauvoei* was isolated from six muscle pieces received from the field and collected from animals dying of black-quarter. *C. septicum* was isolated from one and both organisms from one. The modified method of producing the vaccine for black-quarter, using liver infusion broth with sodium thioglycollate, was adopted for the commercial manufacture of the vaccine at the Institute. An outbreak of the so-called 'circling disease' in sheep in Madras State was investigated, and the disease was found to be enterotoxaemia. The intestinal contents of one of the affected sheep revealed the presence of type 'D' toxin, and *Cwelchii*; type D, was isolated from the intestinal contents of another sheep. Fifty-four strains of *C. welchii* have so far been isolated from specimens received from the States. Studies on evolving a suitable medium for producing *C. welchii* toxin in sufficient quantities were taken up during the year. So far the cooked meat medium has proved somewhat better than the other media used.

Helminthiasis

The scheme for working out the life-history of certain helminth parasites affecting livestock, determining their pathogenicity, and developing suitable methods of control continued to progress at the I. V. R. I. Experimental infection with miracidia of *Schistosoma indicum* in the small *Indoplanorbis exustus* resulted in 21 out of 91 snails of the 1-7 days age group and 10 out of 134 snails of the 8-30 days age group taking up the infection. Infestation with *S. indicum* was set up in a calf by means of cercariae administered orally, and eggs appeared in the faeces 77 days following the initial dose. Preliminary experiments conducted on the treatment of five affected sheep with anthiomaline and tartar emetic showed that the parasites were killed by tartar emetic and not by anthiomaline. A technique was devised for the specific diagnosis of animal schistosomiasis, based on the identification of the miracidia. About 90 per cent. of the embryonated eggs of *Ascaris vitulorum* remained viable for seven months in the laboratory.

Helminthiasis in poultry

The scheme to investigate the factors controlling the resistance of poultry against helminths and to study the biology of the common helminth parasites of poultry was in progress at the I.V.R.I. It was

found that nutritional deficiencies, like those of vitamin 'A', calcium and phosphorus lowered the resistance of chicks against *Ascaridia galli* infection. Observations made on experimental infection with *A. galli*, revealed that a slight primary infection induced sufficient resistance to subsequent heavy infection of the parasite in chicks and that this resistance remained active for about five weeks, even in the absence of the worms of primary infection. Preliminary trials on the effect of testosterone on the natural resistance of male chicks to *A. galli* showed that the rate of infection decreased in chicks treated with the hormone as compared to the controls. In the case of female chicks treated with diethylstilboestrol, the infection increased in the treated chicks.

The *Stephonoflasis* scheme sanctioned to investigate and devise control measures for 'hump core' continued to function in Orissa during the year. Treatment of 148 clinically affected animals with an ointment containing 1 per cent. butyl-sulphate and 2 per cent. hetrazan was tried. The lesions in treated animals were found to have healed, but the drug could not prevent recurrence of the sore.

In addition, schemes for the control of liverfluke in Mysore State and for the mass vaccination of poultry against Ranikhet disease in Poona district were in progress.

APICULTURE

Out of the two regional centres for research in 'bee-keeping' set up during 1951 by the Council, the centre at Katrain in Punjab has been closed down. The centre at Coimbatore continued during the year, and here selective breeding of colonies of bees was carried out which revealed that the progenies of such colonies fared better. The influence of weather on nectar secretion and concentration in *Gliricidia* and *Sesbania* was studied. It was found that soil moisture influenced favourably the secretion of honey. Biometrical studies of the specimens of bees collected in the various parts of the State were also made during the year. Studies on the biology and control of the enemies of bees were carried out. The easiest method of warding off loss due to the wasp, *Vespa cincta* was to shift the body of the hive to the very front of the base board, leaving no space for these wasps to alight on.

PISCICULTURE

The Annamalai University pisciculture scheme continued to function at the zoological laboratories of the University. Studies on the seasonal variations in gonads of the various species was taken up during the year. It was noticed that in the case of *Ophicephalus striatus*, the ovaries attained maturity during the months of June, July and August. The estimation of Vitamin 'C' in the ovary of *Ophicephalus striatus* revealed that its quantity remained constant throughout the year. Experimental induction of gonad development in *Ophicephalus* revealed that by injecting 'antuitrin' "S" intramuscularly, the ovary of the treated fish was enlarged and contained a large amount of oil.

A scheme for the survey of the fish fauna of Sagar (Madhya Pradesh) was taken up during the year at the Zoology Department

of the University of Sagar. The Betiva river system, Ken river system, and the lakes and reservoirs in the district were surveyed, and 44 species belonging to 30 general and 33 species belonging to 20 genera were collected from rivers and lakes etc. respectively.

RINDERPEST

It will be recalled that the work of mass production of freeze dried rinderpest goat tissue vaccine was taken up at the Indian Veterinary Research Institute in order to meet the demand of such parts of the States where mass vaccination and marking of about 10 million cattle and buffaloes were undertaken under the Pilot Project for the eradication of Rinderpest from the Southern Peninsula. The areas concerned were three districts of Mysore, the whole of Coorg, six districts of Andhra, two districts of Bombay and one district of Hyderabad. This work was taken up to gain experience and knowledge prior to undertaking work on a large scale, for launching an all-out drive for the eradication of the disease from the country. To prevent the ingress of the disease into the areas rendered disease-free in the States of Madras and Travancore-Cochin, 20 quarantine stations were established all along the northern border of Madras State and the existing sea quarantine stations were strengthened. Researches were also continued at the Indian Veterinary Research Institute with a view to studying various strains of Rinderpest virus in order to find out a cheap and efficient product for protecting such highly susceptible animals as the hill and cross-bred cattle.

To achieve the target, the work of mass production of vaccine and mass vaccination of animals in the States was pursued vigorously during the whole of the year. Up to the end of March, 1956 95,02,290 doses of Rinderpest vaccine were produced at the Indian Veterinary Research Institute and 71,67,185 doses were supplied to the States under the Pilot Project.

For administrative reasons and to ensure continuity of work, two more districts were added in each of the States of Bombay and Hyderabad to the target which was raised to 12 million cattle from the original target of 10 million. Up to the end of March, 1956, 52,99,499 cattle and buffaloes in the various States as indicated below were vaccinated and marked.

Andhra	26,52,215
Hyderabad	7,10,458
Bombay	8,76,617
Coorg	1,45,497
Mysore	<u>9,11,712</u>
Total	52,99,499

The work in Coorg State has been completed and an appreciable progress has been achieved in all the other States. Statistical analysis of the work done revealed that as against a target of 100-150 vaccinations per day originally fixed per individual vaccinator, it had been possible to do only 60-70 vaccinations per day. The Central Rinderpest Control Committee reviewing the progress of work at its third meeting held during January, 1956, recommended the adoption of certain methods for improving the speed of work under the scheme.

The Indian Veterinary Research Institute, for want of certain facilities, was unable to meet the full demand for vaccine and hence arrangements were made for the supply of $1\frac{1}{2}$ lakh doses of vaccine monthly, from the Institute of Veterinary Preventive Medicine, Ranipet. To keep a check on the potency of the vaccine used, a number of viability tests were carried out in the remote corners of the areas covered by the scheme.

Work in the quarantine stations in Madras continued to progress and up to the end of March, 1956, 3,40,796 animals were vaccinated and banned entry into the whole of the area covered.

The result of all this work has been that there has been no outbreak of the disease in the whole of the area covered.

Method of marking of vaccinated animals

As objection was raised to the method of hot branding for the marking of animals, and as the mark produced faded away or was so severe as to cause complications, the Central Rinderpest Control Committee suggested some alternate methods. Accordingly, trials were conducted with metal tags made of aluminium and copper. Although the aluminium tags were found satisfactory, their cost was prohibitive. Simple punching of the ear has also been tried and would perhaps prove satisfactory.

Proposals for the continuation of work during the Second Five Year Plan.

The Central Rinderpest Control Committee, after a good deal of discussion at its meetings held in Ranchi, Kurnool and Delhi, and after seeing the field work in the States, finalised proposals for continuation and extension of work to cover all the States in the Indian Union during the Second Five Year Plan Period so as to completely rid the country of the menace. A plan costing Rs. 2.82 crores was drawn up and approved by the Planning Commission, as indicated below :

	Rs.
State share	1.24 crore
Govt. of India's share	1.58 crore
	2.82 crore

DAIRYING

Using Haryana milking cows for work at I. V. R. I.

The scheme was started in December, 1952, at the Indian Veterinary Research Institute, with a view to find out whether Haryana cows could be profitably used for draught milk production and breeding purposes. Twenty-four Haryana cows were selected on the basis of their lactation yields and body-weights, and were equally divided into work and no work groups by pairs. The animals to be employed for draught trials were trained and their necks were massaged to prepare them for bearing the yoke. The animals were kept on a balanced diet. The milk yield of all the cows were recorded twice daily. From the analysis of the data on milk yield, it was observed that the lactation yields of working cows were adversely affected. The average body-weights of the work and no-work cows at first calving were 774 and 800 lb. respectively. An initial drop in

the body-weight of working cows was observed during the training period. This however, remained steady after the training period was over. The birth weights of the calves born to work and no-work groups were recorded. It was observed that the birth weights of all the first born calves were un-affected by work. Studies on the breeding capacity of the work and no-work groups were continued. From the data so far collected the calving intervals were recorded as 525.0 days for the work group and 466.6 days for the no-work group.

HIDES AND SKIN

Manufacture of fat Liquors for leather production from Indian hides and skins from indigenous raw material

The scheme began functioning from February, 1954, at the Central Leather Research Institute, Madras. During the year under report, five vegetable oils and three mineral oils were studied to find out a cheap and effective method of refining them for purposes of sulphation. Bubbling air through the oils improved their quality for sulphation and this method was cheap. Preliminary studies on sulphation of oils with sulphuric and other acids and on the preparation of fat-liquors and their comparative efficacy in fat-liquoring were also undertaken. The cost of fat-liquor prepared from sulphated fish oil was Rs. 0-13-9 as compared to Rs. 1-12-0 for Cremol F, and Rs. 1-14-0 for Cremols which were imported.

Improvement of shoe upper and industrial leather

This scheme began functioning at the Central Leather Research Institute, Madras, from February, 1954, with the object of improving the quality of shoe upper and industrial leather made from Indian raw hides and skins by chrome and other mineral tannages. During the year under report, work was conducted on the standardisation of procedures and techniques employed in the preparation of chrome liquors by the addition of sugar (glucose or sucrose) in various proportions to a mixture of potassium dichromate and sulphuric acid. Studies were also undertaken on the formation, etc., of gaseous products, aldehydic products, volatile acids (especially formic acid), non-volatile acids and the cationic, anionic and non-ionic complexes.

Manufacture of crome 'retan' leather from cow hides for the manufacture of heavy boots for the army

The scheme was started in February, 1954, at the Leather Research Institute, Madras, with the object of producing from Indian cow hides, through retanning and using vegetable tanning material, leather of sufficient thickness and strength for army boots, etc. During the year under report, experiments with chrome liquor and other tanning materials were conducted. It was observed that changes in pH value of vegetable tan-liquor within the range of 3 to 5 had no appreciable influence on the uptake of vegetable tanning from retanning baths in the case of liquors made from goran, konan, myrobalans and babul. In the case of liquor made from wattle, however there was an increase of fixation with an increase in pH.

Manufacture of leather boards from leather shavings and cuttings

The scheme started functioning in March, 1954 at the Leather Research Institute, Madras, with the object of manufacturing leather boards from waste products like leather shavings and cuttings. Experiments on suitable methods of making leather boards of sufficient thickness were conducted. Optimum proportions of various constituents of leather boards were determined. A mixture of one part chrome and two parts leather shavings gave satisfactory results. The use of binder (latex) at 40 per cent. resulted in a hard board suitable for insoles. Preliminary detanning of leather shavings was found necessary for removing the excess tanning material, and for this, soda ash and dilute caustic soda proved good. Addition of saw dust resulted in hard boards which cracked readily, and of pulped paper and wood pulp gave boards suitable for insoles.

CHAPTER IV—STATISTICAL RESEARCH

ADVISORY WORK

The statistical Branch of the Council continued its advisory work relating to the design of agricultural and animal husbandry experiments and the interpretation of their results, examination of technical programme and annual reports of the Council's schemes and the scrutiny of statistical papers received for publications in the Council's Journals. A number of statistical enquiries received from the Food and Agricultural Organisation of the United Nations, Central Governments, State Governments and other Institutions were also dealt with.

TRAINING

The post-graduate training courses in Agricultural Statistics were conducted by the Council as usual.

In the first session of the reorganised post-graduate training courses in Agricultural Statistics, four students were admitted to the Diploma 2nd Year Course and eight to the Diploma 1st Year Course and twelve Junior Certificate Course. The results of the Annual Examinations were satisfactory.

A Training Centre in Agricultural Statistics was established in January, 1955, at New Delhi, under the joint aegis of the I. C. A. R. and the Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, for the training of the State Revenue and Land Record Officers with a view to acquaint them thoroughly with the new standard definitions and concepts in improved methods of collecting and compiling Agricultural Statistics. In all, 72 State Revenue and Land Record Officers deputed by 23 State Governments, received about ten weeks intensive training in three consecutive batches. The third and the final batch of twenty six officers completed their training on the 11th November, 1955. Besides lectures on Land Records and elementary statistical methods, the training programme included *inter alia* group discussions among the trainees in the land record systems in vogue in different States and on the experience and problems, both technical and administrative, of collection of agricultural statistics.

A refresher course, for the Senior Research Officers responsible for planning and guiding research in the field of Agriculture in the States and central institutes, was conducted by the Statistical Wing of the Council from the 13th February, 1956, to the 25th February, 1956. Twenty-four Senior Agricultural Research Officers from various States and central institutes attended the course. It is now proposed to institute a series of such refresher courses in future.

A special training in 'Field Work' in connection with agricultural surveys, sampling for area and yield statistics and crop-cutting

experiments was imparted to the students of the Statistical Training Courses and they were stationed for the purpose for about a month at the Central Mechanised Farm, Nandpur, Jammu. Besides this, a number of educational tours were undertaken and all the Diploma Course students were taken to the Central Rice Research Institute, Cuttack, the I. V. R. I., Izatnagar, and the session of the Indian Science Congress at Agra. The Senior and Junior Course students were shown the activities of the Government Livestock Farm, Hisar, the Rice Research Station, Nagina, and the Fruit Research Station Saharanpur. All the students of the Statistical Training Courses were taken to the National Dairy Research Institute, Karnal. The students also received training in official statistics for about a fortnight in different branches at the Directorate of Economics and statistics, Ministry of Food and Agriculture.

A short training programme was arranged for the benefit of the Marketing officers who underwent training in the Directorate of Marketing and Inspection. The training programme included lectures and practical work on the following subjects :

- (i) Quality control and Simple inspection plans
- (ii) Sampling in Surveys
- (iii) Statistical methods useful in the analysis of data relating to marketing of agricultural produce
- (iv) Livestock statistics and surveys.

The 7th Convocation for awarding diplomas, certificates and prizes to the candidates successful in the examinations of the Statistical Training Courses in Agricultural Statistics and to the winners of the All India Crop Competitions was held on the 24th February, 1956, under the presidentship of Shri A. P. Jain, Minister for Food and Agriculture.

Shri M. P. Upadhaya, a student from Nepal was granted a scholarship by the Government of India, under the Colombo plan, for undergoing two years special training in large scale sample surveys.

THEORETICAL RESEARCH

Shri A. V. K. Sastry enjoyed the Fellowship in Animal Husbandry upto the 1st September, 1956, for the research related to the 'Statistical study of some selection programmes in animal breeding.'

The following papers and books were written by the members of the Statistical Branch during the year under report (1955-56) :

Dr. V.G. Panse

Statistical Methods for Agricultural Workers by Dr. V.G. Panse and Dr. P.V. Sukhatme.

Dr. B.V. Sukhatme

An abstract of paper on the "A sympteti Distribution of U Statistics Modified by the introduction of Parameters (*Preliminary Report*) (*The Annals of Mathematical Statistics* Vol. XXVI No. 1st March, 1955).

Shri T.P. Abraham and

Shri G.C. Mohanty

An experimental investigation on Sampling for yield. Tillers and Height in replicated Field Experiments on Rice. (Reprinted from the *Indian Journal of Agricultural Science*, 1955 Vol. XXV Part IV December).

RESEARCH

Pilot sample survey on pepper crop in Madras and Travancore-Cochin, 1955-56

In pursuance of the recommendation of the Spices Enquiry Committee, a pilot sample survey for the estimation of area and yield of pepper and collection of information on cultivation practices and their influence on production was started during the year 1954-55 in the states of Madras and Travancore-Cochin. A preliminary analysis of the data showed the average dry yield of pepper per bearing standard as 23.3 oz. with a sampling error of 5.1 per cent. in Travancore-Cochin, and 14.5 oz., with a sampling error of 6.0 per cent. in Madras. In the total population of standards, the proportion of bearing standards was 90 per cent. for Malabar district and about 85 per cent. for the South Canara district of Madras and 59.8 per cent. for Travancore-Cochin. The total number of standards in Travancore-Cochin was estimated as 21.68 millions. The estimated total production of dry pepper was 8260 tons in Travancore-Cochin.

The pilot investigations were repeated during the year under review to gain further experience in the cultivation practices of the crop and to establish the results obtained last year. The design of the investigations was slightly modified in the state of Travancore-Cochin, where the cross-sections of low-land, mid-land, and high-land regions with 12 *taluk* groups were taken as the strata in place of mid-land regions used as strata in 1954-55. To cover the entire pepper growing area of the two states, the survey was extended to two more new *taluks* of Travancore-Cochin. In the light of the experience gained in the previous year, and due to the extension of the survey, the number of field staff in each State was enhanced.

Survey of fertilizer practices

Two pilot sample surveys on fertilizer practices were initiated during 1954-55 in the West Godavari district of Andhra State and the Coimbatore Districts of Madras State representing the Southern Agricultural Region. The preliminary analysis of the data from the West Godavari district showed that 78 per cent. of the cultivated area in the Godavari district was manured, out of which 55 per cent. received bulky manures alone. Twenty-seven per cent. of the cultivated area was benefited by fertilisers alone or by fertilisers in combination with other types of manures. It was also observed that the major portion of all the important crops was manured. The highest percentage of the area benefited was under sugarcane being 100 per cent.; only 78 per cent. of the area under paddy which is a major crop accounting for about 68 per cent. of the total cultivated area in the district was manured, whereas only 53 per cent. of the area under tree crops, vegetables and spices was found to be manured. Twenty-eight per cent. of the area under paddy, 65 per cent. under sugarcane, 40 per cent. under tobacco and 20 per cent. under tree crops, vegetables and spices were benefited by ammonium sulphate. Fifty-three per cent. of the area under sugarcane was benefited by mixtures and 40 per cent. by oil cakes. One fifth of the area under paddy was manured by penning and about one third by FYM and compost. Sixty per cent. of the area under millets,

70 per cent. under pulses and 71 per cent. under oilseeds were found to receive farm yard manure and compost. As high as 29 per cent. of the area under millets was penned by sheep.

The rate of application of ammonium sulphate per acre for paddy was found to be 83 lb., for tobacco 189 lb., for sugarcane 425 lb. and for tree crops, vegetables and spices 573 lb.

The analysis of the data from the Coimbatore district was in progress.

During 1953-56, a similar type of pilot survey was undertaken in the Shahabad district of Bihar representing the Eastern Agricultural Region. The field work has just been completed.

Marine Fisheries

Malabar Coast. In continuation of the extension survey conducted during 1954-55 for the estimation of marine fish catch, another survey was initiated on the Malabar coast during 1955-56 with the object of perfecting the sampling technique evolved from earlier surveys for adoption by the departmental staff who are entrusted with field work. The coverage was, as in the earlier extension surveys, 160 miles of the Malabar coast and the duration of the survey was proposed to be eight months from October, 1955 to May 1956.

The design adopted was the same as for the earlier survey for the year 1954-55, except for the difference that instead of randomly choosing one centre and four days threat, a fresh centre was randomly chosen on each of the four days randomly selected in each month and for each fish curing yard. The survey was in progress during the year under report.

The analysis of the data collected in the survey during 1954-55 was completed.

The estimate of total catch due to craft units for the survey period and for the entire coast was 23.8 lakh maunds which is of the same order as the estimate obtained for the corresponding period during 1953-54. The percentage standard error associated with the estimated total cost was 8.6.

Andhra Coast. Reference was already made (*vide* Annual report 1954-55) to the extension survey conducted on this part of East Coast of India during 1954-55. The details of the design adopted were as follows :

The design adopted was one of stratified multistage sampling. The coastal region of 600 miles was divided into 12 blocks of 50 miles each and the blocks constituted strata. From each of the strata, a single centre was selected at random every week (defined as six days while the other day left was utilised for transit of enumerator from centre to centre). Field work on each day was conducted for eight hours from 10 A. M. to 4 P. M. and one of the two hours periods 6 A. M. to 8 A. M., or 8 A. M. to 10 A. M. or 4 P. M. to 6 P. M. Each of the two hours periods being repeated twice a week.

The survey started in November, 1954, and completed by the end of October, 1955.

The data received for the initial months was rejected since they were found to be unreliable and scrappy. From the data received from the month of March, the estimate of total catch (day-landings) due to craft and shoreseine units for the eight month period for the entire cost was of the order of 3.8 lakh maunds.

Madras Coast (Catamaran Coast on the east)

Reference was already made (*vide* Annual Report 1954-55) to the survey on this part of the East Coast of India, wherein organisational and technical details of the surveys were furnished.

The survey was started in the middle of December, 1954, and was continued for full twelve months. The receipt of returns from the jurisdictions of Tutiform and Madurai was complete while for the other two, *viz.*, Vellōre and Tanjore there were gaps yet to be filled up.

However, from the analysis of the returns so far received, a tentative estimate of the total catch due to craft units was obtained as 9.1 lakh maunds for the entire coast and the survey period.

Pilot sample surveys for the estimation of Marine Fish Catch on Kanara and North Bombay Coasts

During the fishing season of 1954-55, two pilot surveys on the typical strips of the Indian Coast were implemented. The coverage and the designs adopted for these surveys have already been reported in the previous year's Annual Report. After the completion of the fieldwork, the data collected were statistically analysed and the results submitted to the Statistical Committee at the meeting held in April, 1956.

The total catch for the Kanara coast for the period (September 1954-April, 1955) was estimated at 5.11 lakh maunds, 70 per cent. of which was by the use of Rampari nets. For the North Bombay coast from the end of December, 1954, to June, 1955, the total estimate of catch was 9.15 lakhs maunds.

Livestock Sample Survey, Bombay

The object and design of Livestock sample survey has already been referred to in the earlier report of 1954-55.

The field work of the survey came to a close by June 1954. The tabulation and the statistical analysis of data, based on returns from 880 villages and 91 towns selected from the state (excluding Greater Bombay) has been completed.

The total bovine population for the State, at the time of the survey which was estimated at 17.9 millions with an estimated sampling error 2.3 per cent. showed an increase of 11.6 per cent. over the corresponding figure at the time of 1951 census. The total number of bovine cattle and buffaloes in rural areas were estimated to be 15.4, 11.7 and 3.7 millions with 2.0, 2.3 and 4.1 per cent. sampling errors respectively. The corresponding figures for the urban area were

found to be 2.4, 1.5 and 0.9 millions with 11.5, 9.1 and 7.9 per cent. sampling errors. The estimated totals for cattle under four categories, viz., (i) Males over three years, (ii) Females over three years, (iii) Youngstock between one and three years, and (iv) Youngstock below one year were 46.7 per cent., 28.4 per cent., 16.0 per cent. and 8.9 per cent. of the total cattle respectively. The corresponding figures for buffaloes were 8.3 per cent., 54.0, 22.3 and 15.4 per cent. of the total buffaloes respectively. Out of the total cows estimated in the State about 32.0 per cent. were found in milk at the time of the survey.

The number of carts in the State was estimated at 1.6 millions. Contributions from rural areas of the State accounted for about 81.7 per cent. of the total. The total number of ploughs in the State was estimated at 4.2 millions of which 3.8 millions were contributed from the rural areas of the State. Out of the total 4.2 million ploughs, wooden ploughs accounted for 91.0 per cent.

The average number of male and female cattle above three years per house were 1.0 and 0.6 respectively and that of the youngstock was 0.6. The corresponding figures for buffaloes were 0.1, 0.4 and 0.3. The average number of adult male cattle estimated per cart and per plough in the State was 3.8 and 1.5 respectively.

The pilot surveys in Etawah District in U. P. in 1951 and in Wardha District in Madhya Pradesh in 1953 and the State-wise survey in Bombay in 1954 have established the feasibility and usefulness of the sampling methods for rational supervision of livestock census work. It has also confirmed that it is possible to get an independent and timely estimates of livestock numbers with reasonable accuracy for major categories for broad administrative units of the Indian Union by the method of random sampling.

The technique was proposed to be applied for sample verification of the last Livestock census work conducted in April, 1956, with doublefold objectives, viz.,:

- (1) To check the accuracy of enumeration work of census, and
- (2) To build up an independent estimate of the livestock numbers.

The scheme could not be implemented as it was transferred to the Directorate of National Sample Survey in April, 1956.

Sample survey of sugarcane (1955-56)

Random sample surveys for the estimation of production of sugarcane were initiated during 1954-55 in the States of Punjab, Hyderabad, Andhra, Madhya Bharat, Pepsu and Bombay (Ahmednagar District only). The data received from these States were analysed. The average yield of cane for various States varied from about 16 to 31 tons per acre and its sampling error varied from 3.00 to 3.58 per cent. except for Ahmednagar District (Bombay) where comparatively smaller number of experiments were conducted. A comparison of the official and survey estimates of production of cane and *gur* revealed that the official estimates were underestimated in all States except Ahmednagar District. The *gur* to cane ratio was found to vary from State to State the lowest ratio being 9.29

per cent. for Madhya Bharat and the highest 12.11 per cent. for Hyderabad. The study of plot size was alone taken up in the survey. For this purpose, two plots one of size 33 ft. $\times$ 33 ft. and the other of size 33 ft. $\times$ 16½ ft. were tried. A study of the results has shown that it should be possible to obtain reliable estimates of yield based on the smaller of two plots.

The sample surveys on sugarcane were continued during 1955-56 in the States of Punjab, Hyderabad and Andhra and were initiated for the first time on a State-wise basis in the State of Madras. The sampling plan for the surveys continued to be the same as in the last year except for some modification in the light of the experience gained. The field work was in progress.

Scheme for evolving a technique for assessing cost of milk production

With a view to evolving a suitable technique for ascertaining the cost of milk production in urban and rural tracts, large scale enquiry was commenced in September, 1953, and was conducted in the urban and rural areas of Delhi State. The field work has spread over two years in order to ensure that at least one calving interval was covered during the period of enquiry, and further to provide data on two full sets of seasons (Winter, Summer and Rainy) which would enable the study of seasonal variations in the cost of milk. The details of the field work had already been reported in the annual report for 1954-55. Briefly, after classifying the urban stables into four categories depending upon the number of animals in the stable, a representative sample of 54 stables was drawn. In the rural area, after dividing it into four zones, 24 villages (drawn from all the zones) were selected and from each village four stables were drawn at random so as to obtain 96 rural stables in all.

The data pertaining to the first year enquiry (12th October, 1953 to 11th October, 1954) was statistically analysed and the results presented to the *ad hoc* Milk Costing Committee.

Some of the salient features of this report are as under :

(1) The overall average milk yield per milch animal per day was 6.8 seers in the urban area whereas it was only 2.4 seers in the rural area. Although seasonal variation in milk yield per milch animal was absent for urban area, in the case of rural area the milk yield was maximum during winter (2.73 seers) and least during summer (2.10 seers).

(2) The net urban estimate of the cost per seer of milk was 8.74 annas and the corresponding rural estimate was 7.89 annas. The sampling errors of these estimates were 0.25 anna and 0.27 anna respectively, which were well within the accepted margin of error of less than one anna for both the urban and rural areas.

(3) The item of feed comprised the largest component of milk cost in urban as well as rural sectors (65 per cent. and 71 per cent. respectively of the total cost). The feeding cost (with it naturally, the cost of milk production) was the highest for the winter season in both the areas, and was lowest in summer in the urban area and in the rainy season in the rural area.

(4) Other major items of cost were depreciation on animals in the urban zone (19 per cent) and unpaid labour in the rural zone (17 per cent).

The analysis of the data of the second year of enquiry was in progress.

Fertiliser demonstration trials in cultivator's fields

In order to popularise the use of fertilizers, the Government of India initiated in March, 1954, an All India Fertiliser Demonstration Trial Scheme. The fertilisers for these demonstrations were given free of cost under the Indo-U. S. Technical Assistance Programme. Under the scheme, 3-plot demonstrations were carried out throughout the country in various crops.

The report summarizing the results of 7,000 demonstrations conducted during *kharif*, 1954, had already been submitted (*vide* report of the results of Fertiliser Demonstration Trials in India, *kharif*, 1954-55). During the year, the data of about 5,700 demonstrations of the *rabi* season of 1954-55, mostly relating to wheat and second crop of paddy were received in the Council for statistical analysis. The data on wheat were received from Bombay, Madhya Pradesh, Kutch and Vindhya Pradesh, while data on the second crop of paddy were received from Madras, Mysore and Travancore-Cochin.

The results of the report are given below :

Moderate to high responses were obtained for irrigated wheat at 30 lb. nitrogen for all districts and the average being 3.4 maunds per acre. High responses were obtained on the mixed red and black soils of Vindhya Pradesh (4.23 maunds per acre) and in the alluvial soils of Bombay and Kutch (3.5 maunds per acre). The additional response to 30 lb. P₂O₅ per acre was low, average being 1.3 maund per acre. The average responses to nitrogen and phosphorus for unirrigated were comparatively low.

In the case of the second crop of paddy, the response to 30 lb. nitrogen varies from 4 to 8 maunds per acre, the average being 5.8 maund per acre. The additional response to 30 lb., P. O. was 3.4 maund per acre.

The difference in response to ammonium sulphate and urea was small, and there were indications of better response to urea for some soils.

The scheme was continued in the year 1955-56, with some modifications in the types of demonstrations.

T. C. M. agronomic trials of fertilizer use

Under the Indo-U. S. Technical Co-operation Programme operational agreement No. 4 of 1952 on the determination of soil fertility and fertilizer use, an all-India scheme on fertilizer trials was initiated in the *kharif* season of 1953. The main object of these trials is to estimate the response to different sources of nitrogen and phosphorus in major soil-climatic regions and to correlate the crop responses with the soil data. Under the scheme simple five or six plot

trials are carried out in randomly selected cultivators' fields in some of the community project centres and complex factorial experiments are carried out in selected 15 acre blocks taken base from the cultivators. The experiments are being carried out in nearly 40 centres about half of which are community project centres. The experiments are confined to paddy and wheat except for one complex experimental centre on jowar. This is the third year of the scheme.

The results of the experiments conducted in 1953-54, and 1954-55 have been reported already. The data of paddy experiments for 1955-56 have been statistically analysed. The main conclusions arrived at are as follows :

Average response to nitrogen in the form of ammonium sulphate at 20 lb. N. per acre was 2.5 md/acre which is nearly the same as the response obtained last year. The response was very high in the medium black soil of Bhagwai, and red loam soil of Maruterer, which confirms the results of the previous year. An additional response of about a md/acre was obtained by increasing the nitrogen level from 20 to 40 lb. N/acre. The average response to phosphate at 20 lb. per acre was about 1.5 md/acre. The highest response was obtained last year; residual response to the application of super was also noted at some of the centres.

Under simple trials on cultivators' fields, nitrogen gave good response in general, the average response to 20 lb. N/acre being 4.83 md/acre. The response to N was very high in the grey and brown soils of Indo-Gangetic basins and the red and fallow soils of Raipur, but was low in the coastal alluvial soils. The average response to 20 lb. P_2O_5 /acre was 2.9 md./acre which was 1.41 md./acre less than the response obtained in 1954-55. No significant differences were observed at any centre between the various sources of nitrogen.

Analysis of Bihar manurial experiments

Simple six-plot experiments were continued during 1954-55 on cultivators' fields in a number of thanas in each district of Bihar. The main objects of the experiments were (i) to determine responses of various crops to different fertilizers under cultivator's conditions, and (ii) to study the variation in responses over different soil types. The analysis of the data from the experiments conducted during 1954-55 was completed and report presented at the meetings of the Scientific Committees during April, 1956.

There were six types of experiments for paddy and wheat, one type each for maize and *maruwa* and two types for gram. The selection of villages within *thanas* and fields within villages for the final application of treatment was made at random. For estimating response to a particular treatment, estimates from different types of experiments were combined, using the number of experiments in each type as the weight. The combining of results from different districts to obtain response for the whole State also proceeded on similar lines. The standard errors of the estimated response were obtained by the method appropriate to the sampling technique adopted for the selection of fields.

Average response (in md/acre) for the whole State for 1954-55 for important crops and treatment are produced below. The figures within brackets indicate the number of experiments on which each average is based.

Treatments	Paddy	Wheat	Maize	Maruwa
25 lb. N	4.58 (710)	3.73 (730)	4.19 (347)	2.75 (128)
50 lb. N	6.89 (476)	5.78 (498)	6.50 (347)	4.99 (128)
20 lb.*	2.96 (710)	2.12 (730)	2.03 (347)	2.35 (128)
40 lb. P	4.34 (376)	3.48 (498)	3.33 (347)	4.12 (128)
20 lb. K**	1.39 (468)	1.19 (483)	1.82 (347)	1.04 (128)
40 lb. K**	1.52 (476)	1.12 (479)		

The statement given above shows that nitrogen alone and phosphate in conjunction with nitrogen gives good response. There is an indication of the responsiveness of Bihar soils to potash also.

The superiority of phosphate in the form of super over bonemeal has been observed for most of the crops, the increase in response being 2.76 and 3.52 md./acre for wheat and paddy respectively. The results of this year are consistent with those of 1953-54.

CRITICAL SUMMARIZATION OF THE RESULTS OF CO-ORDINATED PULSES RESEARCH SCHEME

The work on the scheme was taken up in the year 1941 in nine States of the Indian Union. The object of the scheme was to evolve high yielding strains of pulses resistant to disease and drought and to determine the most suitable proportions in which cereals and legumes should be grown in mixed cropping.

The statistical analysis of the entire data with the object of critical summarization of the results was completed during 1954-55. The summarization of the results did not prove to be straight-forward as the number of different strains tried for selection work for any pulse varied from year to year. Through the technique of the analysis of variance, a comparison had thus been possible only among those strains which were common for most of the years. Such comparison has revealed that in some States a number of strains significantly better than the local varieties could be raised.

In the case of mixed cropping experiments, the object of the analysis had been two-fold, viz., (1) to find the crop mixture which proved more economical than others considering the total production of all the crops together, and (2) to investigate if there was any competition among the crops grown so as to favour or affect adversely some crops in the mixture. The results showed that in Orissa the

* Responses to different level of phosphates have been obtained in the presence of nitrogen.

**Responses to different levels of potash have been obtained in the presence of nitrogen as well as in the presence of nitrogen and phosphate.

total income from the mixture (60 lb. paddy and 15 lb. biri per acre) was almost double of that of paddy under pure cropping. In Madhya Pradesh mixed cropping of gram with wheat left an adverse affect on the yield of gram. The results from Madhya Bharat revealed that mixed cropping of jowar, arhar and mung with seed rates in the proportion of 64:9:29 proved most economic. The mixed cropping experiment in Hyderabad with jowar, groundnut and tur indicated that growing on one row of tur after every six rows of jowar gave the maximum economic returns.

ANALYSIS OF CATTLE BREEDING DATA

During the year under report, studies on the Kangyam herd at the Livestock Research Station, Hosur, the Gir herd at the Indian Dairy Research Institute, Bangalore and the Tharparkar herd at the Government Cattle Farm, Patna, were carried out.

Kangyam herd at Livestock Research Station, Hissar

The lactation records analysed numbered about 1800 from 484 cows. The number of bulls used on the herd was 30. About two-thirds of the progenies born were those of the foundation bulls; consequently the bulk of the stock was outbred.

The mortality rate for calves under one year was 6.4 per cent for males and 7.0 per cent for females. The mortality rates for heifers, cows, bull calves above one year and bulls were 2.3 per cent 6.6 per cent, 2.7 per cent and 10 per cent respectively.

Weaning of calves at birth was not practised and culling of calves before completion of a year was negligible. About 24 per cent of the female progenies that survived in the farm upto one year were culled before calving. Selection of cows was practised after successive lactations and it was based largely on the milk yield. The net phenotypic and the expected genotypic gain achieved through selection of cows was of the order of 11.2 per cent and 3.2 per cent respectively per generation.

Lactation correction factors by Sander's method were worked out for lactation yields and other related characters. Maximum yield was reached generally in the third or the fourth lactation.

A greater concentration of freshenings observed in April to June was against fewer calvings in December and January; but season of freshening did not have material influence on the lactation yield. The effect of the environmental changes from year to year was examined by fitting constants. The average first lactation yields (adjusted for generation) were uniformly low for the period 1944 to 1950.

The heritability co-efficients estimated by intra-sire regression method indicated that about 58 per cent of the variation in lactation yield, 52 per cent in yield per day of lactation and 35 per cent in yield per day of calving were attributable to genetic causes. These results indicate a greater scope for improvement through selection for lactation yield than for the other two yield characters.

A comparison of the average performance of cows belonging to different generations indicated a marked improvement from the foundation stock to the first generation, the lactation yield rising from 1376 lb. to 1651 lb. But deterioration occurred in every successive generation after the first, the level of production falling from 1651 lb. from the first generation to 844 lb. for the fifth. Another disconcerting feature is the increase in the age at first calving from about three years and four months in the first generation to four years and five months in the fifth.

Of the seventeen bulls which could be progeny-tested, two bulls, viz., 39 and 119 were found to be meritorious having (corrected daughter average) sire indices of 2174 lb. and 1919 lb. respectively per lactation as against a herd average of about 1400 lb.

Gir herd at the Indian Dairy Research Institute, Bangalore

The lactation records analysed numbered about 400 from 109 cows. The number of bulls used on the herd was 15. Though the herd size was small, the extent of inbreeding was low as about two thirds of the progenies were those of foundation bulls.

The mortality rates for male calves under one year was 20 per cent as compared with 10 per cent for female calves. The rates of mortality for heifers, cows, bull calves above one year and bulls were 3 per cent., 7 per cent., 12 per cent and 6 per cent respectively.

Culling practised on female calves under one year was only 3 per cent prior to 1945 but for the period 1945 to 1952 it was as high as 35 per cent. Culling of heifers above one year also showed similar trends. The selection of cows was practised on successive lactations, the average number of lactations completed being about four. A greater concentration of freshenings was observed in January and February as against fewer calvings during March to August; the season freshening did not show any material influence on the yield.

The estimate of heritability for lactation yield was 0.67 which indicated that about two-thirds of the variation in this character can be attributed to genetic causes.

The first generation cows were on an average superior to their dams, the increase in the lactation yield being 680 lb. over their dams' level of 2460 lb. No material change in yield level was observed from the first to the second generation.

Of the five bulls which were progeny tested, Bhagwan and Ranji were rated as the best two having (corrected daughter average sire) indices of 3400 lb. and 3200 lb. for lactation yield as against a herd average of about 3000 lb.

Tharparkar herd at the Government Cattle Farm, Patna

The lactation records analysed numbered about 2200 from 491 cows. As many as 88 bulls were used on the herd.

The heritability of lactation yield for the dams of the current herd estimated by intensive method was 0.45. When records of cows' root in the current herd were included the heritability fell down to 0.12. The reason for the apparent fall in the genetic variability is being investigated.

A comparison of the average lactation yield of cows belonging to different generations indicated that changes in the production level was negligible. The average lactation yield for the farm-bred cows was 2916 lb.

None of the 13 bulls tested had indices significantly higher than the herd average. Bull 16/0 having an index of 3211 lb. were rated the best and the second best.

On the basis of the analysis carried out, suitable recommendations were made for each herd.

Sampling technique for wool analysis

The assessment of attributes of wool quality presents a problem in sampling. With a view to evolving a suitable method of sampling wool from fleece and commercial bulk, a scheme was undertaken by the Council in 1950. The observational work was carried out at the Sheep Breeding and Wool Research Laboratory, Poona, and the statistical analysis was undertaken at the headquarters of the Council.

The statistical examination of the data on fleece samples for the attributes of length, fineness, medullation and fleece density of wool was completed last year. During the year, the data on samples from commercial bulk were analysed on similar lines and a report presented to the Scientific Committees. The study showed that the optimum method to adopt would be a sub-division into 32 lots and procedure 1 or a few repeated divisions and pooling sub-samples from each. It was found necessary to examine eight samples to estimate the average fibre diameter with a standard error of 2 per cent which meets the usual requirements. With a bunch of about 100 fibres drawn from each of these to be examined for length, the estimate of average fibre length would be obtained with a standard error of about four and half per cent while the medullation percentage studied simultaneously with diameter would be assessed with a standard error or roughly 15 per cent. These conclusions as well as those for fleece samples are to be considered tentative. The study of fleece samples revealed the necessity of drawing composite samples. Further observational work appears to be necessary before definite recommendations can be made.

Rinderpest eradication scheme

Periodical returns were received from the field staff working in the Pilot Project for the Eradication of Rinderpest and were subjected to scrutiny and compilation. The object of this was not only the summarisation of the formulation of a reliable basis for the costing of future operations, the estimation of the man power required for immunising a given livestock population within a specified time and the collection of information concerning the optimum organization of field operations.

The progress of work done from the inception of the scheme up to 25th February, 1956, was summarised from the weekly returns received from the field staff. Sometime study was made and results thereof were incorporated in the report submitted to the Statistical Committee held in April, 1956.

The salient features of the report are as follows. (1) The percentage of animals vaccinated is of the order of 71 on the whole. It varies from State to State, the maximum being in Hyderabad (84) and the minimum in Bombay (53). (2) The average number of doses of vaccine used for vaccinating 100 animals varies from 116 to 132 excepting in Coorg for which the figure is 154, the reason for the high value being that animals could be got only in the small groups. (3) The percentage of animals vaccinated in quarantine stations varies from 76 to 97. (4) There is much variation from State to State with regard to the average total time spent by a party in field operations. This time ranges from 4 to 10 hours. (5) It is observed that as the party size increases, the number of vaccinations for the party per day generally decreases. This indicated that it is preferable to have parties of smaller size for efficient outturn of work.

The study on the cost of vaccination per head is being made along with the monthly assessment of the progress of work of the scheme.

Statistical analysis of data from Hissar Sheep Breeding Scheme

The breeding policy followed in the sheep breeding scheme, Hissar, which ran from 1936 to 1946 involved a good deal of inbreeding. The data were analysed to study the effect of inbreeding on the wool-yield (as obtained from the total of the first two clips) and weight of male and female progenies. The birth-weight and wool-yield records were grouped according to the inbreeding co-efficients of progenies and the differences between groups tested by the analysis of variance.

Another object of the study was to separate out the additive genetic dominance and environmental components of variation in these two characters from the records of non-inbred progenies and thereby to obtain the heritability of these characters in different generations. The Sib method was used to obtain these estimates. Further analysis of the data pertaining to this study was in progress.

Agricultural economics

An Agricultural Economics Committee was set up by the Council in 1954 for the intensification of research into agro-economic problems and for the co-ordination of research activities on the subject undertaken by the various research activities of the country. The Committee had been of the view that the basis of research in agricultural economics should be kept fairly wide. It however approved the following subjects :

- A. Production and land-use economics of the farm and village
- B. Consumption economics of the family
- C. Marketing and prices of farm products

- D. Rural credit
- E. Rural housing
- F. Land tenure
- G. The nation as an economic unit
- H. Population and food supply

Some of the important schemes falling within each of these main heads are indicated below by way of illustration :

A. Production and land-use economics of the farm and village :

(a) Farm Management :

- (i) Improvement of farm techniques
- (ii) Cost of production studies
- (iii) The study of crop rotations and combinations
- (iv) The study of investment—output investment, income ratios with reference to mechanisation
- (v) The relation between the size of the farm, existing techniques and the utilisation of various resources
- (vi) The size of economic holding in relation to existing techniques and importance of mixed farming and diversification of agriculture to this problem
- (vii) Economics of mechanisation

(b) Labour requirements and employment :

- (i) Duration of the period of maximum requirements in labour
- (ii) Range of variations from the maximum to the minimum
- (iii) Total annual pattern of employment including family and labour
- (iv) Existing practices in employment of labour such as exchanging of man and bullock labour
- (v) Payments for labour in kind and cash
- (vi) The existing conditions in operations of paying artisans and others
- (vii) Determination of the volume of unemployment and under-employment in rural sector.

(c) Combinations of agriculture activity with non-farm activity :

- (i) Migration of families or individuals for outside seasonal work
- (ii) Combinations of non-agricultural activities in trade, transport of rural industry within the village
- (iii) Labour on local public works
- (iv) Studies of rural artisan economy
- (v) Studies of differential mobilities of different classes in villages
- (vi) Studies of certain other rural classes such as shepherd, fishermen, etc.
- (vii) Introduction of marginal activities such as planting of trees, vegetable growing, poultry keeping, goat rearing, etc.

- (d) *Determination of the optimum size or sizes of farm units under different conditions*
- (e) *Relationship between the size of the holding and the nature of agriculture practised thereon in respect of efficiency, employment, income, crop, credit techniques, etc.*

B. Consumption economics of the family:

- (i) Food consumption and requirements with reference to variations in cereals and substitute crops such as root crops or other products in the off-season.
- (ii) Consumption pattern and standards in relation to farm business and improvements.
- (iii) Education in consumption and production practices.

C. Marketing and prices of farm products :

- (i) Measurement and analysis of price spreads and cost of distribution to provide basic data for suggesting improvement in marketing system.
- (ii) Study and analysis of prices, movements and inter-grade and inter-market price differentials.
- (iii) Comparative study of different systems of sale, viz., closed bid, open auction, etc., and their influence on prices paid to farmers in the primary markets.
- (iv) Study of methods of estimating marketing supplies, changes in demand and other factors which influence daily prices in the markets.
- (v) Comparative study of economics of marketing by co-operatives and private firms.
- (vi) Studies pertaining to expansion of consumer's demand.
- (vii) Studies in economics of transport, processing, warehousing, etc.
- (viii) Factors governing the size of the marketable surplus either of a region or of a commodity or of both.
- (ix) Studies of individual commodity problems including supply, demand, prices, utilisation etc.

D. Rural credit :

- (i) Extent and nature of capital formation in rural areas.
- (ii) The role of various credit agencies with reference to the purpose and terms of the loans and their influence on rural development, rural incomes, rural savings and the conduct of farm and non-farm activity.
- (iii) Special studies relating to co-operative movement with reference to suitable size of the co-operative relations with the members (terms for loans, arrangements for supervision etc.) relations with Central Financing Institutions (terms of borrowings, acceptance of supervision etc.) and relationship with non-members (terms offered to depositors, traders, etc.).

E. Studies in rural housing:

- (i) In over crowded regions.
- (ii) Improvements in village layouts and structures.

(iii) Co-operative action and utilisation of local materials.

F. Land Tenure :

- (i) Economics and social implications of the abolition of landlordism.
- (ii) Tenancy problems.
- (iii) Distinction in operation and results between owner-operated and tenant-operated farms.

G. The Nation as an economic unit :

- (i) Relationships between agricultural and non-agricultural prices.
- (ii) Relative prices of agricultural commodities and their influence on the structure of agricultural production.
- (iii) Stabilisation of prices.
- (iv) Impact of foreign markets on the requirements and structure of internal production.
- (v) Inter-relationships between the prices and output of different crops.
- (vi) Effects of irrigation projects with reference to output, utilisation, marketable surplus etc.
- (vii) Inter-relationship between agricultural prices, money incomes and the volume of employment.
- (viii) Relationships between rural and urban areas in terms of migration, markets, supplies etc.

H. Population and food supply :

The above list has been drawn out merely for the guidance of such research workers and institutions as are in a position to help in the conduct of agro-economic research and take advantage of the facilities offered by the Agricultural Economics Committee of the I.C.A.R. However, suitable schemes falling outside the above list would also be considered for assistance by the I.C.A.R. on merit.

The sub-committees of the Agricultural Economics Committee were appointed for (i) preparing model schemes of an all-India nature in agricultural economics research and (ii) drawing up a model syllabus in agricultural economics for under-graduate and post-graduate classes.

Thirty-one research schemes on Agro-Economic subject had so far been received by the Council for financial assistance. A brief account of work done under the schemes current at present is given below :

1. Method and practice of farm accounts, Gokhale Institute of Politics and Economics, Poona.

The object of the scheme was (i) to evolve a farm accounts book suitable for keeping the farmers themselves and (ii) to evolve methods by which the keeping of farm accounts could be popularised among farmers.

The scheme was started in six districts, three (North Satara, Nasik and Karwar) in Bombay State, two (Buldana and Wardha) in Madhya Pradesh and one (Osmanabad) in Hyderabad. The work at Nasik and Wardha did not progress satisfactorily and had since been discontinued. The number of farm account books which are being maintained satisfactorily at each of the remaining four centres is as below :

District	No. of Account books
i. North Kanara	50
ii. Karwar	100
iii. Buldana	125
iv. Osmanabad	50

2. *Research Fellowship to Shri Kishen Kanungo for Economics of Multipurpose River Valley Project in India*

The object of this scheme was to discover a suitable method, of economic appraisal of river valley project and to study the character of regional transformation that was about to occur. The necessary material had been collected by Shri Kanungo and was being processed and tabulated for the submission of thesis of the Delhi University.

3. *Nature and Extent of Non-farm employment in rural areas of Gujrat (Bombay State), School of Economics and Sociology, University of Bombay*

The object of the scheme was to determine the exact nature and extent of non-farm employment available in the rural areas of Gujrat and steps to be taken for its extension.

For the purpose of field investigation, three schedules—(i) for occupational census of the village families, (ii) for producing village basic information and (iii) for non-farm families—were designed. The Thana district was divided into nine zones and 50 or about 3 per cent of the villages were selected for the survey. From among the 50 selected villages, three villages were found to have no non-farm families. On the whole 539 families were pursuing farm activity and 431 non-farm activity. The field enquiry in connection with this survey started from February 15, 1955 and was completed by the middle of June 1955. The research project was in the second phase and work relating to designing the analysis-frame for the data collected during the field survey was in progress.

Sampling and Operational Research

The progress in the development and use of sampling techniques for estimation of crop acreages and yields has been remarkable, to which reference has already been made. It is necessary to develop suitable techniques for estimating the production of fruits, spices and vegetables, animal husbandry products like wool, eggs, etc. and for estimating the incidence of diseases and pests on crops. The estimation of damage to the crop and consequent reduction of yield is a more complicated problem but is worth attempting. The statistical assessment of control of insect pests by means of insecticides through controlled field experiments, and bio-assays or sampling study in the field, has received little or no attention in the past in India, and deserves serious study owing to its increasing economic importance.

The statistical assessment of the results of Grow More Food Campaign for which a technique was developed by the Indian Council of Agricultural Research is an example of operational research in agriculture. Another fertile field for such research is the study of agricultural and animal husbandry practices in different tracts. It is only through such operational studies that an accurate quantitative assessment of the present condition of farming in relation to the use of implements, manuring, crop varieties and of livestock in relation to breeds, feeding etc. can be made. Such surveys form the most reliable basis for formulating the developmental plans and will serve as a benchmark for periodic assessment subsequently of the degree of progress achieved in use of improved implements, fertilizers, improved seeds, better breeds of livestock, better standards of feeding etc.

Field experimentation

Very little work has been done for the development of horticultural products. Most suitable experimental designs for horticultural crops are urgently needed on the basis of the study of variability of the experimental material. Apart from the long period required for such experiments, lack of efficient experimental designs has been an important factor in experimental work on horticultural crops lagging far behind as compared to annual crops.

Similar considerations apply to nutritional and other experiments with animals. Here again a study of the extent and pattern of natural variability in characters like milk production in cattle, wool production in sheep, egg production in poultry, which are the subject of experimental investigation, is required in order to recommend efficient practical designs.

CHAPTER V

HIGHER AGRICULTURAL AND VETERINARY EDUCATION

Consequent upon the Government's decision that the entire country should be covered by the National Extension Service Blocks during the Second Five Year Plan, the position regarding requirements and availability of agricultural and veterinary graduates was carefully reviewed on a regional basis, and it was decided to render financial assistance to the State Governments for the following schemes aimed at increasing the output of agricultural and veterinary graduates.

Agricultural education

- (i) Expansion of training facilities at four of the existing agricultural colleges.
- (ii) Establishment of three new agricultural Colleges—one each in Rajasthan, Bihar and Travancore-Cochin.
- (iii) Rehabilitation of the Punjab Agriculture College at Ludhiana.

The above schemes are designed to provide additional seats for training of 400 agricultural graduates per year. All the three new agricultural colleges have started functioning from the academic year 1955.

Veterinary education

- (i) Starting of four new Veterinary Colleges—one each in Andhra, Orissa, Travancore-Cochin and Madhya Bharat.
- (ii) Expansion of training facilities in six of the existing veterinary colleges.
- (iii) Starting double shifts at five of the existing veterinary colleges.
- (iv) Institution of two-year diploma course in veterinary science at 10 centres in various parts of the country.

In view of the urgent need for trained personnel, all the above schemes were put into operation during the year 1955, i.e., one year ahead of the Second Five Year Plan. These measures are designed to train about 1,800 additional veterinary graduates and 2,000 veterinary diploma holders by the end of the Second Five Year Plan.

Inter-Institutional arrangements under the Indo-American Technical Cooperation Programme

Most of the existing agricultural and veterinary institutions in India are at present poorly equipped. In order to strengthen these institutions, the Government of India have developed inter-institutional arrangements with five U.S. Universities on a regional basis. Under these arrangements, India has been divided into five regions and each of the contracting Institution in U.S.A. will cooperate with

the States in the region allotted to them by providing technical assistance. The arrangements provide for an assistance in the following directions:

- (i) Deputation of 42 experienced staff members from American Universities for teaching and research work in India.
- (ii) Fellowship for 35 Indian staff members for advanced training in selected subjects in U.S.A.
- (iii) Class-room, laboratory and field equipment including technical books and journals not ordinarily available in India.

Joint Indo-American Education and Research Team

A joint team of Indian and American specialist was appointed by the Government of India in November, 1954, to make a comparative study of the organisation, function and working of the Indian and American Institutions engaged in agricultural education and research and to make recommendations for removing some of the critical deficiencies in the existing facilities for agricultural research and education in India. The Team after having visited the various research and educational institutions in India and U.S.A. submitted its Report to the Government in October, 1955. Most of the recommendations of the Team have been accepted by Government in principle and steps are now being taken to implement them as early as possible.

Refresher Courses in agriculture for young farmers

A scheme was sanctioned by the Indian Council of Agricultural Research in 1952 for organising short refresher courses in agriculture for the benefit of young farmers so that they could utilise the knowledge thus gained in developing their own lands. During the year under review the scheme was in operation in the States of Madhya Pradesh, Andhra, Hyderabad and Madras, where it has become popular with the farmers. The total number of farmers trained under the scheme up to the end of March, 1946, was 504.

CHAPTER VI—PUBLICATIONS

SCIENTIFIC JOURNALS

The publication of Council's scientific journals, viz., the Indian Journal of Agricultural Science and the Indian Journal of Veterinary Science and Animal Husbandry, which generally remained in arrears were published regularly. The get-up of the journals have also been greatly improved and these are now printed on papers of superior quality.

Statistical Newsletter

This quarterly bulletin which reports the activities of the Statistical Wing of the Council and other items of interest to the Statisticians was published regularly. Popular articles contributed by statisticians are published in this bulletin which contains useful information for agricultural workers. The bulletin continued to be widely distributed both in India and abroad. Its get-up has been improved and it is now printed on superior paper of good quality.

Horticultural Abstracts

This monthly periodical contains abstracts, summaries and extracts from various journals, annual reports, bulletins, circulars, etc., published in India and abroad on horticulture. The main object of the bulletin is to keep the research workers in the country posted with latest developments in the field of horticultural research in India and abroad. Steps were taken to improve the quality of the periodical and its get-up has considerably improved.

Occasional publications

The following were published during the period under report :

Scientific Monographs

1. Classification of citrus fruits of Assam by S. C. Bhattacharya and S. Dutt.

Review Series

The publications under this series contain comprehensive information on accomplished results of researches carried out in this country. The following were published :

1. Crop Rotation in India by T. S. Mirchandani and S. Sen.
2. Double Cropping by P. C. Rehaja.
3. Organic Manures by C. N. Acharya.
4. Dry Farming by P. Krishna Rao and S. B. Priyavriha Rao.
5. A Study of shifting cultivation in Assam by M. D. Chaturvedi and B. N. Uppal.

Research Series

The publications in this series report useful information on Agricultural and Animal Husbandry subjects based mainly on the results of terminated schemes financed by the Council from time to time. The following bulletins were published during the year under report :

1. Breeds of Sheep in the Indian Union by H. K. Lal.
2. Twenty-five years of Statistics in Agriculture in India.

Subsidies

The Council continued to give financial assistance to scientific societies which publish scientific journals with a view to promoting and disseminating scientific knowledge. This scheme has helped the continuance of a number of useful scientific journals which would have otherwise ceased publication owing to financial difficulties.

Exchange of publications

The Council has established exchange relations with various scientific institutions all over the world. The council receives journals, reports and other miscellaneous publications in exchange of their publications. The exchange of publications is undertaken on an equitable basis. The publications received in exchange formed valuable additions to the Council's library and have proved to be very useful to the technical personnel.

Indian Farming

Since taking over the journal from the Associated Advertisers and Printers Ltd. Bombay, it has been possible to bring out the journal regularly. The printing of the journal has now been entrusted to one of the best presses in Delhi. Further improvements as regards get-up and contents were maintained. New features were also added.

A special "Sugarcane" number of the journal was also issued during the year on the occasion of the International Sugarcane Technologist's Conference.

Kheti

The Council took over the publication of Kheti from the Controller of Printing and Stationery, Government of India in October, 1956. Since then the journal has been coming out in time. Original articles and features were added in the magazine to make it more useful and popular among the Hindi knowing farmers. The number of subscribers has also doubled during this period.

Farm Bulletins

Publication of the Farm Bulletin Series was continued. The following bulletins were issued during the year :

ENGLISH

1. The Mango in India
2. Manures and Manuring
3. Potato Cultivation in India
4. Cashewnut Cultivation in India

5. Tobacco Cultivation in India
6. Grape Culture in India
7. Cotton Cultivation in India

HINDI

1. Rice Cultivation in India
2. Onion and Garlic Cultivation

Farm News Releases

The Farm News Releases were issued regularly every week. The "News Releases Service" has been much appreciated by all those interested in it. It has now become a permanent feature of the publicity programme of the Council.

Dharti-ke-Lal

The format of the journal has been improved and the number of pages increased. In order to make the journal more interesting to the Village Level Workers a new permanent feature "Experiences of the Village Level Workers" has been added. Copies were also supplied to the Community Project Administration for distribution in the National Extension Service Blocks.

Central Film Library

A Central Film Library was established in the Indian Council of Agricultural Research. During the year under review the activities of the Library were mostly confined to the procurement of equipment and films. A stock of about 160 prints in English as well as other Indian languages, has been built up. Prints were obtained through internal and external sources, both government and non-government. Films are intended to be loaned out to the other Ministries of the Government of India, State Governments, National Extension Service Blocks, Extension Training centres and other organisations engaged in the field of agricultural education, research and extension in India.

T.C.M. Assistance for Agricultural Information Programme

In March, 1955, O. A. No. 34 for obtaining photographic material and additional multilith equipment, which is complementary to the project of providing the States with printing machines, was concluded with the Technical Co-operation Mission. The agreement provides for the supply of equipment worth \$ 2,00,000 for Agricultural Information units in the States and a co-ordinating agricultural publicity centre at the headquarters of the I.C.A.R.

The agreement also provides for technical assistance for the implementation of the following schemes included in the Second Five-Year Plan.

1. Agricultural Information—production and training
2. Display Advisory Service.

AGRICULTURAL INFORMATION WORKSHOPS

The Indian Council of Agricultural Research has initiated programme of Agricultural Information Workshops in each State to ensure that initial training was given to the information workers and the members of the staff in the art of collection and production of information materials on improved agricultural practices in the shape

of illustrated folders, posters, flannelgraphs, etc. At these workshops a number of agricultural experts, editors, artists, development field staff and extension workers get together and discuss the need for mass communication methods in disseminating Agricultural Information. The Workshops are held under the guidance of T.C.M. experts and editorial staff of the I.C.A.R. So far such Information Workshops have been held in six States, viz., Himachal Pradesh, Madhya Pradesh, Bihar, Bhopal, Travancore-Cochin and West Bengal.

SECOND FIVE-YEAR PLAN PROJECTS

To ensure that useful information based on the latest result of research in the field of agriculture and animal husbandry reaches the Village Level Workers and the farmers in a continuous flow, following three schemes have been included in the Second Five Year Plan :

(i) *Agricultural Information—production and training—Scheme*

The scheme aims at strengthening the existing Agricultural Information organisations both at the Centre and in the States. The total cost of scheme is estimated at Rs. 47 lakhs. The scheme envisages (1) Grant of financial assistance to the State Governments in setting up proper Agricultural Information units, (2) Production of teaching films, (3) Supplementing the projection equipment already supplied to the States, (4) Training of State personnel in production of audio-visual aids and dissemination of Agricultural Information and (5) Production of simple visual aid materials.

(ii) *Farm Radio Publicity Scheme*

The scheme aims at more effective use of the broadcasting facilities for disseminating agricultural information both by helping the all India Radio in preparation of rural programmes, and by training State personnel in the art of rural broadcasting. The total cost of the scheme is estimated at Rs. 2.9 lakhs.

(iii) *Supply of agricultural information literature to village Level Workers*

Its objective is to ensure that each village level worker and member of the supervisory staff in the National Extension Blocks is constantly fed with agricultural information which is essential to enable the Village Workers to keep abreast of development in this field. The total cost of the scheme is estimated at Rs. 53.90 lakhs.

A scheme for the supply of Agricultural Information literature to Village Level Workers, Block Development Officers and Project Executive Officers in the Community Project Areas and National Extension Service Blocks has been sanctioned with a view to keeping these Officers posted with latest information relating to Agriculture and Animal Husbandry research work done in the country. From July, 1955 to the end of March, 1956, about 40,000 copies of publications of the value of Rs. 18,000 have been supplied to these Blocks. There has been considerable improvement in the sale of publications. The total sales during the period under report amounted to Rs. 72,400. The net advertisement revenue for the year 1955-56 amounted to about Rs. 67,584 registering an improvement over the previous year by about Rs. 22,786.

CHAPTER VII—GENERAL

LIBRARY

The work of the I.C.A.R. Library during April, 1955 to March 1956 is presented below under the following heads: (1) Acquisition Section, (2) Service Section, (3) Reorganisation of the Library in the New Building, and (4) Library Statistics.

Acquisition Section

The number of publications added during the year was 1300. These were classified and catalogued. Seven lists of additions to the Library were prepared and circulated. These covered a total of 616 entries. The number of catalogue cards prepared was more than 8000.

About 850 sets of periodicals were received in the Library. Of these about 115 were subscribed for and the rest were mostly received on exchange basis, while a few were received as complementary gifts.

Current issues of periodicals numbering 6528 and newspapers numbering 5027 were received and registered. The binding work could not be handled during the year due to shifting of the Library from the Indian Agricultural Research Institute to the New Building.

Service Section

Circulation: Select issues of periodicals numbering 650 were displayed on the reader's table and 610 were circulated to advisers and other officers.

Loan: The total number of loan transactions during the year was 2050.

Consultation: About 7000 publications were consulted within the library.

Bibliographic Service: Besides a number of routine questions, 28 long range reference questions were handled in the Library. These involved searches and compilation of 23 bibliographies on a number of subjects, covering a total of 717 references and 48 typed pages.

Besides the officers of the Council, the Indian Agricultural Research Institute, and Ministries of the Union Government at Delhi, the reference service was extended to (1) Indian National Scientific Documentation Centre, New Delhi, (2) Research Students for thesis work, (3) Pamba River Factory, Travancore-Cochin State, (4) All India Khadi & Village Industries Board, Udaipur, (5) Agricultural College, Poona (6) Principal, Punjab College of Veterinary Science & Animal Husbandry, (7) A Correspondent from New Zealand, (8) Indian Central Sugarcane Committee, (9) Secretary, Indian Central

Oilseeds Committee. In spite of the difficulties and dislocation due to shifting of the Library from the I.A.R.I. to the New Building, there has been considerable increase in the reference work during the year. Seven hundred and seventeen references were listed this year as against 300 in the previous year. The reference service was improved considerably and maintained at a high level.

Press Cutting Service : About 1300 press cuttings were prepared during the year. Of these about 1100 were circulated to advisers and experts of the Council.

Reorganisation of the library in the new building

Previously the Main Library of the Council was situated in one Wing of the Library premises of the Indian Agricultural Research Institute, New Delhi. On 19 September, 1955 action was started to shift the Main Library from the I.A.R.I. to the New Building at Queen Victoria Road, New Delhi. The shifting involved the handling of more than a lakh of books, and a large number of racks, cabinets, tables, chairs, etc., and was completed by November, 1956. In order to rehabilitate the entire Library in the New Building extra staff was employed. All books and publications on Agriculture and Animal Husbandry have been completely rehabilitated.

Organisation of a branch library at the Statistical Wing

All the books and periodicals on Statistics, agricultural statistics and mathematics were transferred to the new building of the Statistical Branch of the Council. This is to be the nucleus of the Council's Branch Library for immediate service to the staff and students in the Statistical Branch. An Assistant Librarian was appointed and has been placed in charge of this Branch Library. Efforts are being taken to make the collection at the Branch Library as far as possible representative of all the subjects.

Library Statistics

Books and publications added	1300
Current periodical issues received	6628
News-papers received	5027
Press cutting service	1300
Number of loan transaction	2050
Consultation service	7000
Number of publications classified	2000
Number of catalogue cards more than	8000

APPENDIX I

Statement showing the number of meetings of the various bodies of the Indian Council of Agricultural Research held during the year 1955-56

1. Meetings of the Local Sub-Committee of the Standing Committee.	4
2. Meetings of the Agricultural and Animal Husbandry Regional Committee.	5
3. Meetings of the Scientific and Commodity Committees	56
4. Meetings of the Board of Research and its Working Parties on Agriculture and Animal Husbandry.	5
5. Meeting of the Board of Extension	1
6. Meetings of the Advisory Board	2
7. Meeting of the Standing Finance Committee	1
8. Meeting of the Standing Committee	1
9. Meeting of the Governing Body	1
10. Annual General Meeting of the Council	1
11. Special General Meeting	1
TOTAL	78

APPENDIX II

Schemes, the continuation of which was sanctioned by the Governing body

Agriculture Schemes

1. Breeding pericularia resistant Paddy, Madras
2. Breeding pericularia resistant Paddy, Andhra
3. Co-ordinated scheme for research on Hybrid Maize, Punjab
4. Co-ordinated scheme for research on Hybrid Maize, Pepsu
5. Co-ordinated scheme for research on Hybrid Maize, Hyderabad
6. Co-ordinated scheme for research on Hybrid Maize, Bihar
7. Co-ordinated scheme for research on Hybrid Maize, Rajasthan
8. Jowar and Bajra, Saurashtra
9. Pre-soaking seeds in Nutrient Salt, Madras
10. Plant Physiology and Plant introduction, Almora
11. Paddy Agromyzid Fly, Hyderabad
12. Nutritive studies on wheat, Indian Agricultural Research Institute
13. Co-ordination of Agricultural Research, I.C.A.R.
14. Physiology of Wheat, Delhi University
15. Banana Research Station, Madras
16. Banana Research Sub-Station, Bombay
17. Banana Research Sub-Station, West Bengal
18. Research on Citrus Fruits, Orissa
19. Training in Fruit Preservation, B.R. College, Agra
20. Description of Important Fruits
21. Preservation and Storage of Fruits and Vegetables, Central Food Technological Research Institute
22. Research on Fruits, Hyderabad
23. Research on Cashewnuts, Travancore-Cochin
24. Manurial Trials on Citrus, Punjab
25. Improvement of Vegetables, Uttar Pradesh
26. Improvement of Vegetables, Bombay
27. Improvement of Tuber Crops, Madras
28. Ginger Research, Madras
29. Research on zira, Rajasthan
30. Foorki disease of Cardamon, West Bengal
31. Medicinal Plants, Kashmir
32. Medicinal Plants, West-Bengal
33. Ergot Scheme, Assam
34. Termite Research Scheme (Taxonomy) F.R.I., Dehra Dun
35. Humification of organic matters, Uttar Pradesh

APPENDIX II—*Contd.**Animal Husbandry Schemes*

36. Poultry Development, Travancore-Cochin
37. Study of the possibility of working suitable draught capacity standard for bullocks, I.V.R.I.
38. To supplement Livestock Investigation, Punjab
39. Survey of Camels in India, I.C.A.R.
40. Post-graduate training in Livestock Marketing
41. Development and standardization of the method for detecting adulteration and estimating major constituents of milk, Punjab University
42. Regional Animal Nutrition, Anand
43. Studies on the influence of trace elements on the health and productive capacity of livestock in India, I.V.R.I.
44. Investigation of Mastitis, Bombay
45. Disease Investigation Officer, Rajasthan
46. Investigation of processing of inedible or unpopular fish caught in West-Bengal
47. Bee-keeping research Centre, Madras
48. Award of two Research Fellowships to carry on advance research in Agricultural Statistics
49. Refresher Course in Agriculture for Young Farmers, Hyderabad
50. Short refresher courses in Agriculture for Young Farmers, Madhya Pradesh
51. Short refresher courses in Agriculture for Young Farmers, Andhra
52. Continuance of library scheme, I.C.A.R.

APPENDIX III

New Agriculture Schemes sanctioned during 1955-56

1. Breeding non-lodging, non-shedding and flood resistant Paddy, Madhya Pradesh
2. Breeding Paddy for lift irrigation Areas
3. Co-ordinated Millet scheme
4. Co-ordinated scheme pre-soaking seeds in nutrient salts, Prof. Dastur
5. Cytology of Grass, Saugar University, Madhya Pradesh Government
6. Breeding Paddy resistant to lodging, C.R.R.I.
7. Studies on Algae, I.A.R.I.
8. Tabil Nursery, Hyderabad
9. Agronomic Experiments with Jowar, Madhya Pradesh
10. Bacterial Blight Disease of Paddy, Bombay
11. Improvement of Musk-Melon and Water-Melon, I.A.R.I. with sub-stations at Delhi, Kulu etc. I.A.R.I.
12. Establishment of Regional Mango (Research Station), U.P.
13. Intensification of research on Mango (Regional Station), Uttar Pradesh
14. Intensification of research on Guava (Regional Station), Uttar Pradesh
15. Establishment of Multi-crop Fruits Research Station (intensification of research), Madras
16. Intensification of research on raisin grapes, Himachal Pradesh
17. Chlorosis of Banana, Bombay
18. All-India Fruits shows, I.C.A.R.
19. Investigation of fruit pests, Andhra
20. Training in Fruit Preservation, Hyderabad
21. Physiological studies of factors governing root-formation in cuttings and layerings of fruit trees, Calcutta University
22. Research on Pests of Citrus, Hyderabad
23. Requisition for the services of a foreign expert for the co-ordinated plant hormone scheme, I.C.A.R.
24. Micro-nutrient station, Coorg. Additional Grant for staff and construction of building, etc., Coorg
25. Evolution of new varieties of Mango, Grapes and Citrus, Punjab
26. Investigation on pests of vegetables, Andhra
27. Research on pests of vegetables and fruits trees, Punjab
28. Improvement of Chillies, Hyderabad
29. Improvement of Chillies, Uttar Pradesh
30. Improvement of Chillies, West Bengal

APPENDIX III. -Contd.

31. Improvement of Chillies, Madhya Pradesh
32. Improvement of Poppy, I.A.R.I.
33. Control of Hairy Caterpillar of Andaman, Coorg
34. Publication illustrated bulletin giving information about cultivation of individual drug plants I.C.A.R.
35. Investigation on the use of distress class of birds feeding on grain crops, Bombay Government
36. Systematic and Biological studies of the rodent fauna of Delhi, Delhi University
37. Intensification of Termite Research, Agriculture Institution, Anand
38. Nutritional and Biological studies on insects, Delhi University
39. Augmenting the names insect collections, Agriculture College, Madras Government, Coimbatore
40. Physiological relationship between insect pests and their host plants Delhi University.
41. Investigation of field rats and methods of their control, Uttar Pradesh
42. Award of prizes for improvements in Agricultural implements, I.C.A.R.
43. Water requirements of crops in the Lower Damodar Valley, D.V. Corporation
44. Sorinkler irrigation, Coorg
45. Agronomic aspects of green manuring, Agriculture College, Poona
46. Nitrogen Fixation, Andhra
47. Usar Land Reclamation, Lucknow
48. Phosphate Reversion in Nilgiris, Madras
49. Composition of Plants in Usar Land, Lucknow University
50. Reclamation of Saline and Alkaline Lands, Madras
51. Phosphorus Nutrition, Andhra
52. Research on Bunda Parasite, Agri. B.R. College, Agra
53. Survey of insect pests in stored pepper, Travancore-Cochin

Animal Husbandry Schemes

54. Cross breeding of Cattle in hilly and heavy rainfall areas second unit in Travancore-Cochin
55. Developing strains of goats for milk production, Director of Animal Husbandry, Bombay
56. Keeping poultry in batteries, West Bengal
57. Duck Breeding Scheme, Director of Animal Husbandry, Andhra
58. Performance of improved Desi strain of Fowls, Travancore-Cochin
59. Performance of improved Desi strain of Fowls, Government of Madras
60. Cross-breeding in poultry, All Agricultural Institutes
61. Revised scheme for the improvement of Sheep and Wool on regional basis, Jammu and Kashmir

APPENDIX III—*Contd.*

62. Revised scheme for the improvement of Sheep & Wool on regional basis, Madras
63. Scheme for defining the characteristics of the breeds of sheep found in North Gujarath, Bombay
64. Selective breeding *vs.* grading up of Marathwada buffaloes, Hyderabad
65. Studies on the scope for the introduction of sterilized milk in India West Bengal
66. Study of the application of bacteriological tests for rating the keeping quality of milk under Calcutta milk supply scheme, West Bengal
67. Study of 'Let down' response of some breeds of Indian cows and buffaloes and the scope for milking them mechanically, West Bengal
68. Survey of bacteriological quality of milk supply in Delhi
69. Compilation and publication of Indian Dairy Yearbook, Vol. I, I.C.A.R.
70. Preparation of compendium on the animal nutrition investigations conducted in West Bengal under the schemes of the I.C.A.R., West Bengal
71. Studies on the food requirements of sheep under range and agricultural conditions, Izatnagar, Bombay
72. Investigation of the effects of feeding some less used feeds as leafy fodders and tree leaves and their possible deleterious effects on domestic animals, West Bengal
73. Survey of the deficiency diseases in livestock in West Bengal
74. Consideration of the Recommendations of the third meeting of the Sub-Committee on Indigenous Drugs, I.C.A.R.
75. Investigation on mastitis, Madras
76. Fascioliasis in remainants, Hyderabad
77. Control of brucellosis, Madras
78. Control of brucellosis, Orissa
79. Luxation of patella in bovines, Orissa
80. Sheep and Goat diseases, Rajasthan
81. Germicidal action of certain common medicines, West Bengal
82. Biology and systematics of hill leeches, Delhi University
83. Hydrobiological faunistic survey of the Godavari Estuaries system, Andhra
84. Ecology of fresh water fishes in U.P., Lucknow University
85. Studies on Boe-flora, Coorg
86. Scheme for the investigation of the possibilities of using cows for work, I.V.R.I.
87. Scheme for evolving a suitable draught capacity standard for bullock, I.V.R.I.

AGRICULTURAL EDUCATION, PUBLICITY SCHEMES, ETC.

88. Setting up an Exhibition Unit, I.C.A.R.
89. Estimation of cost of production of Cotton and other rotation crop, I.C.A.R.

APPENDIX III—*Contd.*

90. Pilot Sample investigation on the cultivation practices of yield of Orange Crops, Madhya Pradesh
91. Pilot Sample investigation on the cultivation practices of yield of mango crop, Uttar Pradesh
92. Investigation of Party practices of Rice and Jute, Visva Bharati University
93. Studies into intensive cultural practice in small holdings, Calcutta University
94. Proposal to invite eminent Statisticians from Japan & India to assist in the Research training programme of the Statistical Wing of the I.C.A.R. under Colombo Plan, I.C.A.R. Scheme
95. Publication of Crop Calenders and charts of Plants Diseases, I.C.A.R.
96. Supply of agricultural Information Literature to the National Extension Service Blocks, I.C.A.R., Delhi
97. Taking over the printing of the Hindi Journal 'Kheti' from the Controller of Printing and Stationery, I.C.A.R.
98. Bringing out publications of the I.C.A.R. in regional languages, I.C.A.R.
99. Publication of Handbook on Horticulture, I.C.A.R.
100. Setting up of Central Co-operative Film Production Unit
101. Publication of I.C.A.R. 'Flowering Trees' of India's I.C.A.R.
102. Award of Prizes for outstanding research work done in the fields of Agriculture, Animal Husbandry and allied science, I.C.A.R.
103. Conference of research workers in agriculture and Animal Husbandry, I.C.A.R.
104. Sanction of expenditure for the Millet Workers Conference, I.C.A.R.
105. Investigation of Nitrogen fixing power of some important leguminous crops, Bombay
106. Additional staff for I.C.A.R. Publication
107. Preparation of Monograph on "Poisonous Plants of India Vol. II".
108. Strengthening of the Distribution Section, I.C.A.R.
109. Setting up of a Pavilion at the All India Cattle Show in P.E.P.S.U., I.C.A.R.
110. Organisation of Agricultural Exhibitions at Colombo and Amritsar I.C.A.R.
111. Augumation of staff for Statistical Wing, I.C.A.R.
112. Creation of post of Director of Art, I.C.A.R.
113. Creation of the post of Section Officer for Publication Wing, I.C.A.R.
114. Sale and Distribution of the Council's publications-purchase of addressing machine
115. Purchase of improved axles and hubs for bullock carts etc. manufactured by National Emporium, Roorki
116. Sale and Distribution of 'Kheti'

APPENDIX IV

Schemes which terminated during 1955-56

- | | | |
|-----|---|----------------|
| 1. | Japanese method of Rice cultivation, | Coorg |
| 2. | Do. | Mysore |
| 3. | Do. | Orissa |
| 4. | Do. | West Bengal |
| 5. | Do. | Bihar |
| 6. | Do. | Madhya Pradesh |
| 7. | Do. | Uttar Pradesh |
| 8. | Do. | Bombay |
| 9. | Do. | Madras |
| 10. | Do. | Andhra |
| 11. | Increasing Rice Yields, C. R. R. I. | |
| 12. | Gram Pests, Madhya Pradesh | |
| 13. | All India Mango Show, I. C. A. R. | |
| 14. | Tuber Crops, Bihar | |
| 15. | Improvement of vegetables, Kashmir | |
| 16. | Investigation of Insect infestation pepper exported to U. S. A., Madras | |
| 17. | Rapid Soil Tests, I. A. R. I. | |
| 18. | Studies on Crop Plants, Andhra University | |
| 19. | Virus diseases, I. A. R. I. (Poona, Delhi & Simla) | |
| 20. | Development of Herbarium cryptogamical Orientals, I. A. R. I. | |
| 21. | Mechanism of polyploidy, Indore | |
| 22. | Introduction of new economic Plants, I. A. R. I. | |
| 23. | Survey of Fertilizer practices, Madras | |
| 24. | Manurial Trials, Bihar | |
| 25. | Manurial Trials, Madras | |
| 26. | Manurial Trials, West Bengal | |
| 27. | Improvement of Goats, Travancore-Cochin | |
| 28. | Nutritive value of indigenous grasses and leafy fodders, I. V. R. I. | |
| 29. | Investigation of mastitis, Mysore | |
| 30. | Contagious caprine pleuro-pneumonia, I. V. R. I. | |
| 31. | Life history of bionomics of goats warble fly in India, I. V. R. I. | |
| 32. | Dry Farming, Madhya Pradesh | |
| 33. | Dry Farming, Bhopal | |
| 34. | Dry Farming, Himachal Pradesh | |
| 35. | Weed Control, Madras | |
| 36. | Poultry Research, Madhya Pradesh | |
| 37. | Helminth parasites affecting poultry, I. V. R. I. | |

APPENDIX IV—*Contd.*

38. Coccidiosis in poultry, I. V. R. I.
39. Fish, fauna and ecology of food fishes, Saugar University
40. Delhi Milk Supply Scheme, I. C. A. R.
41. Refresher Course in Agriculture for young farmers, Kashmir.
42. Refresher Course in Agriculture for young farmers, Bihar.
43. Survey of indigenous implements, Assam
44. Do. Bombay
45. Do. Madhya Pradesh
46. Do. West Bengal
47. Do. Hyderabad
48. Do. Madhya Bharat
49. Do. Travancore-Cochin
50. Do. Bhopal
51. Do. Himachal Pradesh
52. Do. Vindhya Pradesh
53. Training in village blacksmiths, Assam.
54. Training in village blacksmiths, Vindhya Pradesh.

APPENDIX V

List of members of the I. C. A. R. Society

1. Shri Ajit Prasad Jain, Minister for Food and Agriculture, Government of India, New Delhi
2. Dr. Panjabrao S. Deshmukh, Minister for Agriculture, Government of India, New Delhi
3. Shri M. S. Randhawa, Vice President, Indian Council of Agricultural Research, New Delhi
4. Shri M. V. Krishnappa, Deputy Minister for Food and Agriculture Government of India, Ministry of Food and Agriculture, New Delhi
5. Shri B. Gopala Reddi, Minister incharge of Agriculture, Government of Andhra, Kurnool
6. Shri Ram Nath Dass, Minister incharge of Agriculture, Government of Assam, Shillong
7. Shri B. C. Hiray, Minister incharge of Agriculture, Government of Bombay, Bombay
8. Shri A. N. Sinha, Minister incharge of Agriculture, Government of Bihar, Patna
9. Shri S. L. Tiwari, Minister incharge of Agriculture, Government of Madhya Pradesh, Nagpur
10. Shri M. Bhaktavatsalam, Minister incharge of Agriculture, Government of Madras, Madras
11. Shri Nabakrushna Chaudhury, Chief Minister incharge of Agriculture, Government of Orissa, Bhubaneshwar
12. Shri Gurbachan Singh Bajwa, Development Minister incharge of Agriculture, Government of Punjab, Chandigarh
13. Shri Hukam Singh, Minister incharge of Agriculture, Government of Uttar Pradesh, Lucknow
14. Dr. R. Ahmed, Minister incharge of Agriculture, Government of West Bengal, Calcutta
15. Dr. M. Chenna Reddy, Minister incharge of Agriculture, Government of Hyderabad, Hyderabad-Dn.
16. Syed Mir Qasim, Minister incharge of Agriculture, Government of Jammu and Kashmir, Srinagar/Jammu Tawi
17. Shri V. V. Dravid, Minister for Development and Labour, Government of Madhya Bharat, Gwalior/Indore
18. Shri T. Channia, Minister incharge of Agriculture, Animal Husbandry, Veterinary, Fisheries and Co-operation, Government of Mysore, Bangalore
19. Raja Surinder Singh of Nalagarh, Minister incharge of Agriculture, Government of Patiala and East Punjab States Union, Patiala
20. Shri Ram Niwas Mirdha, Minister incharge of Agriculture, Government of Rajasthan, Jaipur

APPENDIX V—*Contd.*

21. Shri R. M. Adani, Development Minister incharge of Agriculture, Government of Saurashtra, Rajkot
22. Shri A. A. Rahim, Chief Minister incharge of Agriculture, Government of Travancore-Cochin, Trivandrum.
23. Shri Haribhau Uppadhyaya, Chief Minister incharge of Agriculture, Government of Ajmer, Ajmer
24. Shri Shankar Dayal Sharma, Chief Minister incharge of Agriculture Government of Bhopal, Bhopal
25. Shri Braham Parkash, Development Minister incharge of Agriculture, Government of Delhi, Delhi
26. Shri Padam Dev, Minister incharge of Agriculture, Government of Himachal Pradesh, Simla—4
27. Shri C. M. Poonacha, Chief Minister for Agriculture, Government of Coorg, Mercara
28. Shri Gopal Saran Singh, Minister for Justice and Planning (Agriculture), Government of Vindhya Pradesh, Rewa
29. Shri S. A. Ghatge, Chief Commissioner of Kutch, Bhuj
30. Shri P. C. Mathew, Chief Commissioner of Manipur, Imphal
31. Major General Hira Lal Atul, Chief Commissioner of Tripura, Agartala
32. Shri I. J. Naidu, Director of Agriculture, Andhra State, Madras—2
33. Shri L. K. Handique, Director of Agriculture, Assam, Shillong
34. Director of Agriculture, Bihar, Patna
35. Dr. T. G. Shirname, Director of Agriculture, Bombay State, Poona
36. Shri Raghunath Narayana Pendharkar, Director of Agriculture and Veterinary Service, Madhya Pradesh, Nagpur
37. Shri P. P. I. Vaidyanathan, Director of Agriculture, Madras, Chepauk, Madras
38. Shri V. S. Tilak, Director of Agriculture, Orissa, Cuttack
39. Shri H. R. Saini, Director of Agriculture, Punjab, Simla
40. Dr. Sant Bahadur Singh, Director of Agriculture, Uttar Pradesh, Lucknow
41. Dr. H. K. Nandi, Director of Agriculture, West Bengal, Calcutta.
42. Shri Rai Prithviraj, Director of Agriculture, Hyderabad State, Hyderabad-Deccan
43. Shri G. M. Butt, Director of Agriculture, Jammu & Kashmir, Srinagar/Jammu Tawi
44. Shri M. G. Karnikar, Director of Agriculture, Madhya Bharat, Gwalior
45. Shri M. Mallara, Urs, Director of Agriculture, Mysore, Bangalore—1
46. Dr. Arjan Singh, Director of Agriculture, Patiala and East Punjab States Union, Patiala
47. Shri Samrath Raj, Director of Agriculture and Food Commissioner, Rajasthan, Jaipur
48. Dr. B. S. Kadam, Director of Agriculture and Animal Husbandry, Saurashtra, Rajkot

APPENDIX V—Contd.

49. Shri N. Sandara Menon, Director of Agriculture, Travancore Cochin, Trivandrum
50. Major T. J. Murari, Director of Animal Husbandry, Andhra State, Madras—8
51. Shri Gopal Krishan Mehra, Director of Veterinary Services and Principal Veterinary College, Assam, Gauhati
52. Shri M. I. Malik, Director of Veterinary Services, Bihar, Patna
53. Shri S. R. Chandha, Director of Animal Husbandry and Veterinary Services, Bombay State, Poona—2
54. Shri V. R. Rajagopalan, Director of Animal Husbandry, Madras, Chepauk, Madras
55. Shri Gurbachan Singh, Director of Animal Husbandry and Veterinary Services, Orissa, Cuttack
56. Shri B. N. Handa, Director of Veterinary Services and Warden of Fisheries, Punjab, Simla
57. Dr. P. G. Pande, Director of Animal Husbandry, Uttar Pradesh, Lucknow
58. Lt. Col. S. Datta, Director of Veterinary Services and Animal Husbandry, West Bengal, Calcutta
59. Dr. K. S. Shetty, Director of Veterinary Services, Hyderabad, Hyderabad, Deccan.
60. Lt. Col. H. K. Mehra, Director of Veterinary Services, and Animal Husbandry, Madhya Bharat, Gwalior
61. Dr. V. L. Wazir, Director of Veterinary Services, Jammu and Kashmir, Srinagar/Jammu Tawi
62. Shri V. S. Kuppaswamy Mudaliar, Director of Animal Husbandry, Veterinary Services and Fisheries, Mysore, Bangalore
63. Sardar Pritam Singh Brar, Director of Veterinary Services, Patiala and East Punjab States Union, Patiala
64. Shri V. K. Madhava Menon, Director of Veterinary Services, Travancore-Cochin, Trivandrum
65. Shri P. N. Thapar, Secretary to the Government of India, Ministry of Food and Agriculture, New Delhi
66. Shri K. Madhava Menon, Member, Rajaya Sabha, 26, Mandi House, New Delhi
67. Sri Beni Prasad Aggarwal, Member, Rajya Sabha, 119-A, Mukhtarani Babu Street, Calcutta—7
68. Shri K. G. Deshmukh, Member, Lok Sabha, Namuna, Amravati, Madhya Pradesh
69. Pandit Algu Rai Shashtri, Member, Lok Sabha, Amila Town, District Azamgarh, Uttar Pradesh
70. Shri Sakhtivadivel Gounder, Member Lok Sabha, Kamayakkavandanpatti, Cumbum P. O., District Madurai, Madras State
71. Dr. Indubhai B. Amin, Member, Lok Sabha, Alembic Colony
72. Shri Ratilal, M. Gandhi, C/o M/s. Ratilal & Co., Gurrimjee Building, 111, Mahatma Gandhi Road, Bombay—1

APPENDIX V—*Contd.*

73. Shri A. R. Foster, C/o M/s. Imperial Chemical Industries (India) Ltd., 18, Strand Road, Calcutta
74. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, Indian Council of Agricultural Research, New Delhi
75. Shri P. N. Nanda, Animal Husbandry Commissioner with the Government of India, Indian Council of Agricultural Research, New Delhi
76. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, Directorate of Extension and Training, Ministry of Food and Agriculture, Government of India, New Delhi
77. Dr. B. M. Ghatge, Agricultural Marketing Advisor to the Government of India, Directorate of Marketing and Inspection, Ministry of Food and Agriculture, New Delhi.
78. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi
79. Shri L. Sahani, Director, Indian Veterinary Research Institute, Izatnagar/Mukteswar
80. Director, Indian Institute of Science, Bangalore
81. Dr. N. Parthasarathy, Director, Central Rice Research Institute, Cuttack
82. Dr. S. Ramanujam, Director, Central Potato Research Institute, Patna
83. Shri K. L. Aggarwal, President, Forest Research Institute and Colleges, P. O. New Forest, Dehra Dun
84. Dr. M. D. Patel, Director of Institute of Agriculture, Anand
85. Dr. K. C. Sen, Director, National Dairy Research Institute, Queen Victoria Road, New Delhi
86. Shri Thakur Das Bhargava, Advocate, Member, Lok Sabha, Anand Bhavan, Hissar
87. The Secretary, Central Board of Forestry, Ministry of Food and Agriculture, Government of India, New Delhi
88. Shri M. S. Thacker, Director, Council of Scientific and Industrial Research, New Delhi
89. Shri C. R. Ranganathan, Inspector General of Forests, Ministry of Food and Agriculture, Government of India, New Delhi
90. Shri B. Venkatratnam Chaudhri, President, Andhra State Co-operative Bank Ltd., Vijayawada
91. Shri K. P. Bhatnagar, Vice Chancellor, Agricultural University, Agra
92. Dr. Radha Kamal Mukerjee, Vice Chancellor, Lucknow University, Lucknow
93. Dr. V. S. Krishna, Vice Chancellor, Andhra University, Waltair
94. Dewan Anand Kumar, Vice Chancellor, Punjab University, Solan
95. Shri K. H. Srinivasan, Kibbetta Estate, Somwarpet P. O. N., Coorg
96. Shri K. Srinivasan, C/o Messrs. A. V. Thomas & Co., Ltd., Alleppey, Travancore-Cochin

APPENDIX V—*Contd.*

97. Shri C. Bab Reddy, Secretary, Andhra Provincial Kisan Sammelan Cumbum, District Kurnool
98. Shri P. Balrama Kurup, Techno-Chemical Industries, P. O. Box No. 74, Kozhikode, Malabar District, Madras
99. Shri Mohanlal Ambalal Parikh, 51, Dady Seth Agiary lane, Bombay—2
100. Shri N. Srikanbah, Honorary Secretary, All India Supari Federation, Sagar, Mysore State
101. Shri Chimanlal B. Parikh, Vice-President, Indian Central Cotton Committee, 28, Appollo Street, Fort, Bombay
102. Shri T. G. Walton, Vice-President, Indian Central Jute Committee, Hastings Street, Calcutta
103. Shri Kotharaguramiah, Member, Lok Sabha, Vice-President Indian Central Tobacco Committee, Harrington Road, Chetpet, Madras
104. Sardar Lal Singh, Member, Lok Sabha, Village and P.O. Nandpur, District Ludhiana
105. Shri K. P. Madhavan Nair, Member, Rajya Sabha, Vice President, Indian Central Coconut Committee, Ernakulam Mills Buildings, Ernakulam
106. Shri A. M. Thomas, Advocate, Member, Lok Sabha, Vice President, Indian Central Arecanut Committee, Ernakulam
107. Dr. S. R. Sen, Economic and Statistical Adviser, Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, New Delhi
108. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi
109. Shri K. L. Ghei, Joint Secretary, Ministry of Finance (Food and Agriculture Division), Government of India and Financial Adviser, Indian Council of Agricultural Research, New Delhi
110. Shri J. V. A. Nehemiah, Secretary, Indian Council of Agricultural Research, New Delhi
111. Shri S. K. Mirchandani, Additional Secretary, Indian Council of Agricultural Research, New Delhi
112. Shri Baburao Krishnaji Patil, Land Holder and President, Digras Municipal Committee, Digras, District Yeotmal, Madhya Pradesh
113. Sardar Satwant Singh, Land Holder, Khulra Kingra, Garden Colony, Jullundur
114. Shri M. P. Gandhi, C/o Gandhi & Co., Jan Mansion, Sir Pheroazsha Mehta Road, Fort, Bombay
115. The Director, Remounts, Veterinary and Farms, Army Headquarters, Quarter Master General's Branch, New Delhi

APPENDIX VI

List of Members of the Governing Body of the Council as on the 31st March, 1956

1. Shri Ajit Prasad Jain, Minister for Food and Agriculture, Government of India, New Delhi
2. Dr. Punjab Rao S. Deshmukh, Minister for Agriculture, Government of India, New Delhi
3. Shri M. S. Randhawa, Vice President, Indian Council of Agricultural Research, New Delhi
4. Shri M. V. Krishnappa, Deputy Minister for Food and Agriculture, Government of India, New Delhi
5. Shri B. Gopala Reddi, Minister incharge of Agriculture, Government of Andhra, Kurnool
6. Shri Ram Nath Dass, Minister incharge of Agriculture, Government of Assam, Shillong
7. Shri A. N. Sinha, Minister incharge of Agriculture, Government of Bihar, Patna
8. Shri B. S. Hiray, Minister incharge of Agriculture, Government of Bombay, Bombay
9. Shri S. L. Tiwari, Minister incharge of Agriculture, Government of Madhya Pradesh, Nagpur
10. Shri M. Bhaktavatsalam, Minister incharge of Agriculture, Government of Madras, Madras
11. Shri Nabakrushna Chaudhuri, Chief Minister incharge of Agriculture, Government of Orissa, Bhubaneswar
12. Shri Gurbachan Singh Bajwa, Development Minister incharge of Agriculture, Government of Punjab, Chandigarh
13. Shri Hukam Singh, Minister incharge of Agriculture, Government of Uttar Pradesh, Lucknow
14. Dr. R. Ahmed, Minister incharge of Agriculture, Government of West Bengal, Calcutta
15. Dr. M. Chenna Reddy, Minister incharge of Agriculture, Government of Hyderabad, Hyderabad-Deccan
16. Syed Mir Qasim, Minister incharge of Agriculture, Government of Jammu and Kashmir, Srinagar/Jammu Tawi
17. Shri V. V. Dravid, Minister for Development and Labour, Government of Madhya Bharat, Gwalior/Indore
18. Shri T. Channia, Minister incharge of Agriculture, Government of Mysore, Bangalore
19. Raja Surinder Singh of Nalagarh Development Minister incharge of Agriculture, Government of Patiala and East Punjab States Union, Patiala
20. Shri Ram Niwas Mirdha, Minister incharge of Agriculture, Government of Rajasthan, Jaipur
21. Shri R. M. Adani, Development Minister incharge of Agriculture, Government of Saurashtra, Rajkot

APPENDIX VI—*Contd.*

22. Shri P. N. Thapar, Secretary, Ministry of Food and Agriculture Government of India, New Delhi
23. Shri A. A. Rahim, Minister incharge of Agriculture, Government of Travancore-Cochin, Trivandrum
24. Shri Hari Bhau Upadhyaya, Chief Minister incharge of Agriculture Government of Ajmer, Ajmer
25. Shri Shankar Dayal Sharma, Chief Minister incharge of Agriculture, Government of Bhopal, Bhopal
26. Shri C. M. Poonacha, Chief Minister incharge of Agriculture Government of Coorg, Mercara
27. Shri Braham Prakash, Development Minister incharge of Agriculture, Government of Delhi, Delhi
28. Shri Padam Dev, Minister incharge of Agriculture, Himachal Pradesh, Simla
29. Shri Gopal Saran Singh, Minister for Justice and Planning (Agriculture), Government of Vindhya Pradesh, Rewa
30. Shri S. A. Ghatge, Chief Commissioner, Kutch, Bhuj
31. Shri P. C. Mathew, Chief Commissioner of Manipur, Imphal
32. Major General Hira Lal Atul, Chief Commissioner of Tripura Agartala
33. Shri Algu Rai Shashtri, Member, Lok Sabha, Amila Town, District Azamgarh, Uttar Pradesh
34. Dr. Indu Bhai B. Amin, Member, Lok Sabha, Alembic Colony, Baroda-3
35. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi
36. Shri P. N. Nanda, Animal Husbandry Commissioner with the Government of India, New Delhi
37. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi
38. S. Lal Singh, Vice President, Indian Central Sugarcane Committee, Village and P. Q., Nandpur, District Ludhiana
39. Shri K. L. Ghei, Joint Secretary, Ministry of Finance (Food and Agriculture Division), Government of India, and Financial Adviser of the Indian Council of Agricultural Research, New Delhi
40. Dr. S. R. Sen, Economic and Statistical Adviser, Directorate of Economics and Statistics, Ministry of Food & Agriculture, Government of India, New Delhi
41. Shri J. V. A. Nehemiah, Secretary, Indian Council of Agricultural Research, New Delhi
42. Shri S. K. Mirchandani, Additional Secretary, Indian Council of Agricultural Research, New Delhi
43. Shri Thakur Das Bhargava, Advocate, Member, Lok Sabha, Anand Bhavan, Hissar
44. Shri Babu Rao Krishnaji Patil, Land Holder and President, Municipal Committee, Digras, Digras, Madhya Pradesh
45. Dr. H. K. Nanda, Director of Agriculture, West Bengal, Calcutta

APPENDIX VI—*Contd.*

46. Dr. S. Dutta, Director of Veterinary Services and Animal Husbandry
West Bengal, Calcutta
47. Shri M. P. Gandhi, Gandhi & Co., Jan Mansion, Sir Pheroz Shah
Mehta Road, Fort, Bombay
48. Sardar Satwant Singh, Land-holder Khurla Kingra, Garden Colony
Jullundur

APPENDIX VII

List of members of the Standing Committee of the Council

1. Shri Ajit Prasad Jani, Minister for Food & Agriculture, Government of India, New Delhi
2. Dr. Punjab Rao S. Deshmukh, Minister for Agriculture, Government of India, New Delhi (*Chairman*)
3. Shri M. S. Randhawa, Vice President, Indian Council of Agricultural Research, New Delhi
4. Shri M. V. Krishnappa, Deputy Minister for Food and Agriculture Government of India, New Delhi
5. Shri Ram Nath Dass, Minister incharge of Agriculture, Government of Assam, Shillong
6. Syed Mir Qasim, Minister incharge of Agriculture, Government of Jammu & Kashmir, Srinagar, Jammu/Tawi
7. Shri Shankar Dayal Sharma, Chief Minister & Minister incharge of Agriculture, Government of Bhopal, Bhopal
8. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi
9. Shri P. N. Nanda, Animal Husbandry Commissioner, with the Government of India, New Delhi
10. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi
11. Sardar Lal Singh, Vice-President, Indian Central Sugarcane Committee, Village and P. O. Nandpur, Distt. Ludhiana
12. Shri K. L. Ghei, Joint Secretary, Ministry of Finance (Food and Agriculture Division) Government of India Financial Adviser, I.C.A.R., New Delhi
13. Dr. S. R. Sen, Economic and Statistical Adviser, Ministry of Food and Agriculture, Government of India, New Delhi
14. Shri J. V. A. Nehemiah, Secretary, Indian Council of Agricultural Research, New Delhi
15. Shri S. K. Mirchandani, Additional Secretary, Indian Council of Agricultural Research, New Delhi
16. Shri Thakur Das Bhargava, Advocate, Member Lok Sabha, Anand Bhavan, Hissar
17. Sardar Satwant Singh, Land-holder, Khulra Kingra, Garden Colony, Jullundur
18. Shri Baburao Krishna Patil, Land-holder & President, Digras Municipal Committee Digras, District, Yeotmal, Madhya Pradesh

APPENDIX VIII

List of Members of the Local Sub-Committee of the Standing Committee

1. Shri Ajit Prasad Jain, Minister for Food and Agriculture, Government of India, New Delhi
2. Dr. Punjab Rao S. Deshmukh, Minister for Agriculture, Government of India, New Delhi
3. Shri M. S. Randhawa, Vice President, Indian Council of Agricultural Research, New Delhi
4. Shri M. V. Krishnappa, Deputy Minister for Food and Agriculture, Government of India, New Delhi
5. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi
6. Shri P. N. Nanda, Animal Husbandry Commissioner with the Government of India, New Delhi
7. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi
8. Shri J. V. A. Nehemiah, Secretary, Indian Council of Agricultural Research, New Delhi
9. Shri S. K. Mirchandani, Additional Secretary, Indian Council of Agricultural Research, New Delhi
10. Shri K. L. Ghei, Joint Secretary to the Government of India, Ministry of Finance, Food and Agriculture Division, and Financial Adviser, Indian Council of Agricultural Research, New Delhi
11. Dr. S. R. Sen, Economic and Statistical Adviser, Ministry of Food and Agriculture, Government of India, New Delhi

APPENDIX IX

List of members of the Standing Finance Committee, as on 31st March, 1956

1. Shri P. N. Thapar, Secretary to the Government of India, Ministry of Food and Agriculture, New Delhi (*President*)
2. Shri M. S. Randhawa, Vice President, Indian Council of Agricultural Research, New Delhi
3. Shri K. L. Ghei, Joint Secretary to the Government of India, Ministry of Finance, Food and Agriculture Division, and Financial Adviser, Indian Council of Agricultural Research, New Delhi
4. Dr. R. Ahmed, Minister in charge of Agriculture, Government of West Bengal, Calcutta
5. Syed Mir Qasim, Minister incharge of Agriculture, Government of Jammu and Kashmir, Srinagar/Jammu Tawi
6. Shri Braham Prakash, Development Minister incharge of Agriculture, Government of Delhi, Delhi
7. Shri M. P. Gandhi, C/o Gandhi & Co., Jan Mansion, Sir Pheroz Shah Mehta Road, Fort, Bombay
8. Shri Algu Rai Shashtri, Member, Lok Sabha, Amila Town, District Azamgarh, Uttar Pradesh
9. Dr. M. D. Patel, Director, Institute of Agriculture, Anand
10. Dr. B. L. Manjunath, Ex-Vice Chancellor, Mysore University, Mysore.

APPENDIX X

List of Members of the Advisory Board of the Indian Council of Agricultural Research

1. Shri M. S. Randhawa, Vice President, Indian Council of Agricultural Research, New Delhi (*Chairman*)
2. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi
3. Shri P. N. Nanda, Animal Husbandry Commissioner with the Government of India, New Delhi
4. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi
5. Dr. M. B. Ghatge, Agricultural Marketing Adviser to the Government of India, Ministry of Food & Agriculture, New Delhi
6. Dr. S. R. Sen, Economic & Statistical Adviser, Ministry of Food & Agriculture, Government of India, New Delhi
7. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi
8. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi
9. Shri L. Sahai, Director, Indian Veterinary Research Institute Izatnagar/Mukteswar
10. Director, Indian Institute of Science, Bangalore
11. Dr. K. C. Sen, Director, National Dairy Research Institute, and Director of Dairy Research, Ministry of Food & Agriculture, New Delhi
12. Dr. N. Parthasarathy, Director, Central Rice Research Institute, Cuttack
13. Dr. S. Ramanujam, Director, Central Potato Research Institute, Patna
14. Shri I. J. Naidu, Director of Agriculture, Andhra State, Madras-2
15. Shri L. K. Handique, Director of Agriculture, Assam, Shillong
16. Director of Agriculture, Bihar, Patna
17. Dr. T. G. Shirname, Director of Agriculture, Bombay State, Poona
18. Shri Raghunath Narayana Pendharkar, I.A.S., Director of Agriculture and Veterinary Services, Madhya Pradesh, Nagpur
19. Shri P. P. I. Vaidyanathan, Director of Agriculture, Madras, Chepauk, Madras
20. Shri V. S. Tilak, I.A.S., Director of Agriculture, Orissa, Cuttack
21. Shri H. R. Saini, Director of Agriculture, Punjab, Simla
22. Dr. Sant Bahadur Singh, Director of Agriculture, Uttar Pradesh, Lucknow
23. Dr. K. H. Nandi, Director of Agriculture, West Bengal, Calcutta
24. Shri Rai Prithviraj, Director of Agriculture, Hyderabad State, Hyderabad-Deccan

APPENDIX X—*Contd.*

25. Shri G. M. Butt, Director of Agriculture, Jammu and Kashmir, Srinagar/Jammu Tawi
26. Shri M. G. Karnikar, Director of Agriculture, Madhya Bharat, Gwalior
27. Shri M. Mallaraj Urs Director of Agriculture, Mysore State, Bangalore
28. Dr. Arjan Singh, Director of Agriculture, Patiala and East Punjab States Union, Patiala
29. Shri Samrath Raj, Director of Agriculture and Food Commissioner Rajasthan, Jaipur
30. Dr. B. S. Kadam, Director of Agriculture and Animal Husbandry, Saurashtra, Rajkot
31. Shri M. Sankara Menon, Director of Agriculture, Travancore-Cochin Trivandrum
32. Major T. Murari, Director of Animal Husbandry, Andhra, Madras
33. Shri G. K. Mehra, Director of Veterinary Services, and Animal Husbandry, Assam, Gauhati
34. Shri S. R. Chadha, Director of Veterinary Services, Bombay State, Poona
35. Shri M. I. Malik, Director of Animal Husbandry, Bihar, Patna
36. Shri V. R. Rajagopalan, Director of Animal Husbandry, Madras, Triplicane, Madras
37. Shri Gurbachan Singh, Director of Animal Husbandry and Veterinary Services, Orissa, Cuttack
38. Shri B. N. Handa, Director of Veterinary Services and Warden of Fisheries, Punjab, Simla
39. Dr. P. G. Pande, Director of Animal Husbandry, Uttar Pradesh, Lucknow
40. Dr. S. Datta, Director of Veterinary Services & Animal Husbandry, West Bengal, Calcutta
41. Dr. K. S. Shetty, Director of Veterinary Services, Hyderabad State, Hyderabad-Dn.
42. Shri V. L. Wazir, Director of Veterinary Services, Jammu and Kashmir, Srinagar/Jammu Tawi
43. Lt. Col. H. K. Mehra, Director of Veterinary Services and Animal Husbandry, Madhya Bharat, Gwalior
44. Shri V. S. Kupuswamy Mudaliar, Director of Animal Husbandry, Mysore State, Bangalore
45. S. Pritam Singh Brar, Director of Veterinary Services, Patiala and East Punjab States Union, Patiala
46. Shri V. K. Madhava Menon, Director of Animal Husbandry, Travancore-Cochin, Trivandrum
47. Shri A. L. Aggarwal, President, Forest Research Institute & College, P.O. New Forest, Dehra Dun
48. Shri B. Venkataratnam Chaudhuri, President, Co-operative Central Bank, Ltd. Ramchandrapuram, East Godavary, Andhra

APPENDIX X—*Contd.*

49. Shri K. P. Bhatnagar, Prof. A. C. Bannerjee, Vice-Chancellor, Agra University, Agra
50. Dr. Radha Kamal Mukherjee, Vice-Chancellor, Agra University, Agra
51. Dr. V. S. Krishna, Vice-Chancellor, Andhra University, Waltair
52. Dewan Anand Kumar, Vice-Chancellor, Lucknow University, Lucknow
53. Shri C. Bab Reddy, Honorary Secretary, Andhra Provincial Kisan Sammelan, Cumham, District Kurnool
54. Shri P. Balarama Kurup, Techno-Chemical Industries, P.O. Box No. 74, Kozhikode, Malabar District, Madras State
55. Shri Mohanlal Ambalal Parikh 51, Dadyseth, Agiary Lane, Bombay-2
56. Shri N. Srikantiah, Honorary Secretary, All India Suppari Federation, Sagar, Mysore State
57. Shri K. M. Srinivasan, Kibbetta Estate, Somwarpet, P. O. North Coorg
58. Shri K. Srinivasan, C/o A. V. Thomas and Co., Ltd., Alleppey, Travancore-Cochin, Trivandrum
59. Dr. E. S. Narayanan, Head of the Division of Entomology, Indian Agricultural Research Institute, New Delhi
60. Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, New Delhi
61. Dr. K. C. Naik, Headquarters Deputy Director of Agriculture, Madras State, Madras
62. Col. R. N. Chopra, Director of Central Drug Research Laboratory, Srinagar/Jammu Tawi
63. Dr. B. Viswa Nath, 8A/85, W.E.A. Karol Bagh, New Delhi
64. Shri D.A. Gadkary, Joint Director of Agriculture Engineering, Bombay State, Poona
65. Dr. N. D. Kehar, Head of the Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar
66. Shri Manilal B. Nanavati, President, Indian Society of Agricultural Economics, 46-48, Esplanade Mansion, Mahatma Gandhi Road, Fort, Bombay
67. Shri H. K. Lal, Deputy Director of Animal Husbandry, Uttar Pradesh, Meerut
68. Dr. S. S. Patel, Adviser (Agriculture) Community Projects Administration, Planning Commission, Government of India, New Delhi
69. Dr. M. D. Patel, Director, Institute of Agriculture, Anand
70. Dr. P. M. Narayanaswami Naidu, Deputy Animal Husbandry Commissioner with the Government of India, New Delhi
71. The Director, Remounts Veterinary and Farms Quarter Master General's Branch Army Headquarters, New Delhi
72. Sardar Lal Singh, Member, Lok Sabha, 70, North Avenue, New Delhi.

APPENDIX XI

List of members of the Board of Research

1. Shri M. S. Randhawa, Vice President, Indian Council of Agricultural Research, New Delhi (*Chairman*)
2. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi
3. Shri P. N. Nanda, Animal Husbandry Commissioner with the Government of India, New Delhi
4. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi
5. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi
6. Shri M. R. Saini, Director of Agriculture, Punjab, Chandigarh
7. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi
8. Dr. E. S. Narayanan, Head of the Division of Entomology, Indian Agricultural Research Institute, New Delhi
9. Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, New Delhi
10. Dr. K. C. Naik, Headquarters, Director of Agriculture, Madras, Madras
11. Col. R. N. Chopra, Director, Central Drug Research Laboratory Srinagar
12. Dr. B. Viswa Nath, 84/85, Western Extension Area, Karol Bagh New Delhi
13. Shri D. A. Gadkary, Joint Director of Agriculture (Engineering), Bombay State, Poona
14. Shri L. Sahai, Director, Indian Veterinary Research Institute, Izatnagar
15. Dr. N. D. Kehar, Head of the Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar
16. Dr. K. C. Sen, Director, National Dairy Research Institute, and Director of Dairy Research, Ministry of Food & Agriculture, Government of India, New Delhi
17. Shri Manilal B. Nanavati, President, Indian Society of Agricultural Economics, 46-48, Esplanade Mansions, Mahatma Gandhi Road, Fort, Bombay
18. Shri H. K. Lall, Deputy Director of Animal Husbandry, Uttar Pradesh, Meerut

APPENDIX XII

*List of members of the Working Party on Agriculture of the Board of Research, as on
31st March 1956*

1. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi
2. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi
3. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi
4. Shri M. R. Saini, Director of Agriculture, Punjab, Simla
5. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi
6. Dr. E. S. Narayanan, Head of the Division of Entomology, Indian Agricultural Research Institute, New Delhi
7. Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, New Delhi
8. Dr. K. C. Naik, Headquarters, Deputy Director of Agriculture Madras, Madras
9. Dr. B. Viswa Nath, 84/85, Western Extension Area, Karol Bagh, New Delhi
10. Col. R. N. Chopra, Director, Central Drug Research Laboratory, Srinagar
11. Shri D. A. Gadkary, Joint Director of Agriculture (Engineering), Bombay State, Poona
12. Shri Manilal B. Nanavati, President, Indian Society of Agricultural Economics, 46-48, Esplanade Mansions, Mahatma Gandhi Road, Fort, Bombay

APPENDIX XIII

List of members of the Working Party on Animal Husbandry of the Board of Research

1. Shri P. N. Nanda, Animal Husbandry Commissioner with the Government of India, New Delhi (*Chairman*)
2. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi
3. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi
4. Shri L. Sahai, Director, Indian Veterinary Research Institute, Izatnagar
5. Dr. N. D. Kehar, Head of the Division of Animal Nutrition, Indian Veterinary Research Institute Izatnagar
6. Dr. K. C. Sen, Director, Indian Dairy Research Institute, New Delhi
7. Shri H. K. Lall, Deputy Director of Animal Husbandry, Uttar Pradesh, Lucknow
8. Dr. S. Datta, Director of Veterinary Services and Animal Husbandry, West Bengal, Calcutta (Co-opted Member)

APPENDIX XIV

List of members of the Board of Extension

1. Shri M. S. Randhawa, Vice President, Indian Council of Agricultural Research, New Delhi (*Chairman*)
2. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi
3. Shri P. Nanda, Animal Husbandry Commissioner with the Government of India, New Delhi
4. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi
5. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi
6. Dr. B. P. Pal, Director Indian Agricultural Research Institute, New Delhi
7. Dr. M. D. Patel, Institute of Agriculture, Anand
8. Shri Laxmi Sahai, Director, Indian Veterinary Research Institute, Izatnagar.
9. Dr. P. M. Narayanaswami Naidu, Deputy Animal Husbandry Commissioner with the Government of India, New Delhi.
- 10 Dr. J. S. Patel, Adviser (Agriculture), Community Projects Administration, Government of India, New Delhi

APPENDIX XV
SCIENTIFIC COMMITTEES

Agricultural Side

PLANT DISEASES COMMITTEE

Subject : Mycology, Bacteriology and virus diseases

1. Dr. S. N. Das Gupta, Professor of Botany, University of Lucknow
2. Shri Babu Singh, Professor of Botany, Agricultural College, Kanpur
3. Dr. J. N. Mishra, Plant Pathologist to the Government of Bihar, Sobour, P. O. Distt. Bhagalpur
4. Dr. Kishan Singh Bedi, Plant Pathologist, Punjab Government Agricultural College, Ludhiana
5. Dr. M. K. Patel, Plant Pathologist to the Govt. of Bombay (Retired), 12-Bombay-Poona Rd. Poona-5
6. Dr. T. S. Ramakrishnan, Rubber Pathologist, Indian Rubber Board, Kottayam
7. Dr. N. Prasad, Professor of Bacteriology and Plant Pathology, Institute of Agriculture, Anand
8. Dr. Raghu Nath Prasad Asthana, Plant Pathologist to the Government of Madhya Pradesh, & Principal, Agricultural College, Nagpur
9. Syed Vaheeddudean, Plant Pathologist to the Government of Hyderabad, Himayatsagar, Hyderabad-Deccan
10. Dr. T. S. Sadasivan, Director, University Botany Laboratory, Madras University, Madras

Ex-officio members

1. Dr. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, New Delhi (*Chairman*)
2. Dr. P. R. Mehta, Deputy Director (Plant Diseases), Directorate of Plant Protection, Quarantine and Storage Ministry of Food and Agriculture, Government of India, New Delhi

MEDICINAL PLANTS COMMITTEE

1. Dr. G. K. Karandilar, Professor of Pharmacology, Medical College, Baroda
2. Shri K. N. Kaul, Director National Botanical Garden, Lucknow
3. Dr. K. P. Biswai, Incharge Medicinal Plant Scheme, Government of West Bengal, Old Hindustan Building, Calcutta-13
4. Shri S. P. Sen of Bengal Chemical and pharmaceutical works Ltd., Chittaranjan Avenue- Calcutta
5. Dr. B. Mukerjee, Director, Drug Research Institute, Lucknow

APPENDIX XV—*Contd.*

6. Dr. N. K. Dutta, Assistant Director incharge, Department of Pharmacology, Haffkin Institute, Parel, Bombay-12
7. Shri D. D. Suri, Officer on Special Duty (Crop Competition), Office of the Director of Agriculture, Punjab, Simla
8. Dr. M. S. Verma, Principal, Ayurvedic College, Banaras Hindu University, Banaras
9. Dr. S. Dutta, Director of Veterinary Services and Animal Husbandry, West Bengal, Calcutta
10. Shri P. M. Nabar, Drugs Controller, Ministry of Health, Government of India, New Delhi
11. Col. R. N. Chopra, Director, Drug Research Laboratory, Srinagar/Jammu Tawi (*Chairman*)

Ex-officio members

1. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi
2. Dr. R. L. Badhwar, Officer in charge, Minor Forest Products Branch, Forest Research Institute, Dehra Dun

AGRICULTURAL ENGINEERING COMMITTEE

1. Shri D. A. Gadkari, Joint Director of Agriculture (Engineering), Bombay State, Poona (*Chairman*)
2. Shri R. V. Ramiah, Head of the Division of Agricultural Engineering, Indian Agricultural Research Institute, New Delhi
3. Shri C. P. Raju, Headquarters Agricultural Engineer, Office of the Director of Agriculture and Fisheries, Andhra, Madras
4. Shri B. N. Banerjee, Agricultural Engineer and Joint Director of Agricultural Engineering, West Bengal, Calcutta
5. Shri A. A. Hakim, Asstt. Professor of Agricultural Engineering, Department of Agriculture, Indian Institute of Technology, Kharagpur, S. E. Rly.
6. Shri M. K. Nandi, Agriculture Department, Voltas, 3, Netaji Subhas Road, P. O. Box 606, Calcutta
7. Shri P. Narashiah, Deputy Commissioner for Small Scale Industries, Ministry of Commerce and Industry, Government of India, New Delhi
8. Shri A. C. Pandya, Assistant Professor of Agricultural Engineering, (Farm Power Machinery), Department of Agricultural Engineering, Indian Institute of Technology, Kharagpur, S. E. Rly.
9. Mr. Mason Vaugh, Professor of Agricultural Engineering, Institute of Agriculture, Allahabad
10. Sardar Jaswant Singh, Executive Engineer (Tube Wells) Government of Patiala and East Punjab Union, Malerkotla

THE ENTOMOLOGY AND ANIMAL PESTS OF CROPS COMMITTEE

Subject : All Aspects

1. Dr. P. J. Deoras, Assistant Director, Incharge, Department of Entomology Haffkin Institute, Bombay-12

APPENDIX XV—*Contd.*

2. Dr. K. N. Trehan, Punjab University College, Hoshiarpur
3. Shri V. Thirumal Rao, Government Pathologist, Andhra State, Bapatla
4. Dr. G. A. Patel, Agricultural Entomologist to Government of Bombay, Agricultural College, Poona-5
5. Dr. M. S. Mani, Professor of Zoology, and Entomology, St. John's College, Agra
6. Dr. R. L. Gupta, Entomologist to Government of Madhya Pradesh College of Agriculture, Nagpur
7. Dr. Mohammad Qudriuddin Khan, Government Entomologist, Hyderabad, Main Farm, Himayatsagar, Hyderabad-Deccan
8. Dr. A. C. Sen, Entomologist to Government, Bihar, Sabour, C/o Dr. S. N. Banerjee, Assistant Entomologist, West Bengal, Calcutta

Ex-officio members

1. Dr. K. B. Lal, Plant Protection Adviser to the Government of India, Directorate of Plant Protection Quarantine and Storage, Ministry of Food and Agriculture, Government of India, New Delhi
2. Shri K. R. Sontakhey, Director of Storage, Ministry of Food and Agriculture, Government of India, New Delhi
3. Dr. E. S. Narayanan, Head of the Division of Entomology, Indian Agricultural Research Institute, New Delhi (*Chairman*)

HORTICULTURE COMMITTEE

1. Sardar Bal Singh Bajwa, Fruit Specialist to the Govt. of Punjab, Jullundur
2. Shri Pradyman Singh, Horticulturist to the Government of Madhya Pradesh, V.T.I., Building, Maharaj Bagh, Nagpur
3. Dr. K. C. Naik, Headquarters, Deputy Director of Agriculture (Research), Madras, Chepauk, Madras (*Chairman*)
4. Dr. D. N. Srivastawa, Deputy Director of Horticulture, Uttar Pradesh, Lucknow
5. Dr. R. I. Nagpla, Horticulturist to the Govt. of Bombay, Agricultural College, Poona
6. Dr. G. S. Cheema, 13, West Maccot Road, East Kirkee, Poona-3
7. Professor W. B. Hayes, Head of the Department of Horticulture, Allahabad Agricultural Institute, Allahabad
8. Shri R. S. Roy, Horticulturist to the Government of Bihar, P. O. Sabour, District Bhagalpur
9. Shri S. C. Bhattacharya, Officer on Special Duty, Agricultural Marketing, Office of the Director of Agriculture, Assam, Shillong
10. Shri S. R. Gandhi, Retired Horticulturist to the Government of Bombay, Padamjee House, 813-14, Bhawani Peth, Poona-2
11. Shri G. M. Butt, Director of Agriculture, Jammu & Kashmir, Srinagar
12. Shri M. H. Marigouda, Superintendent Government Garden, Mysore, Lal Bagh, Bangalore

APPENDIX XV—Contd.

13. Dr. Girdhari Lal, Asstt. Director, (Fruit Technology) Central Food Technological Research Institute, Cheluvamba Mansion, V. V. Mohlla P. O. Mysore

Ex-officio members

1. Shri B. Banerjee, Assistant Director General Technical Adviser, Ministry of Food and Agriculture Government of India, New Delhi
2. The Agricultural Marketing Adviser, to the Government of India New Delhi
3. The Director, Potato Research Institute, Patna

BOTANY COMMITTEE

Subject : Plant Breeding, Cytogenetics and Physiology

1. Dr. B. P. Pal, Director Indian Agricultural Research Institute New Delhi (*Chairman*)
2. Shri Boshi Sen, Director, Vivekanand Laboratory, Almora, U. P.
3. Dr. T. R. Mehta, Principal, Agricultural College and Joint Director Agriculture, Gwalior, Indore
4. Shri Laxmi Singh Negi, Economic Botanist, Cereals, Cotton and Oilseeds, Punjab, 694, Model Town, Jullundur City
5. Shri V. M. Chavan, Deputy Director of Agriculture, (Crop Research) Bombay State, 898, Radha Niwas, Poona-4
6. Shri R. B. Ekbote, Wheat Specialist to the Government of Madhya Pradesh, Hoshangabad
7. Shri P. D. Gadkari, Economic Botanist, Institute of Plant Industry, Indore
8. Dr. A. C. Joshi, Deputy Director, Punjab Education Department Chandigarh
9. Dr. R. H. Richaria, Economic Botanist to Government of Bihar, P. O. Sabour (Bhagalpur)
10. Shri M. B. V. Narasingrao, Principal, Agriculture College, Bapala
11. Dr. A. K. Paul, Economic Botanist to the Government of West Bengal, I Rani Kubir, Tollygunge, Calcutta-33
12. Dr. A. Abraham, Professor of Botany, Travancore University, Trivandrum

Ex-officio members

1. Dr. N. Parthasarty, Director Central Rice Research Institute, Cuttack-4
2. Dr. S. M. Sikka, Head of the Division of Botany, Indian Agricultural Research Institute, New Delhi

APPENDIX XV—*Contd.*

AGRONOMY COMMITTEE

Subject : Agronomic and fodder and grazing

1. Shri Kalidas Sawhney, Ashok Villa, Mettan Guda, Secunderabad (Deccan)
2. Dr. Arjan Singh, Director of Agriculture, Patiala and East Punjab States Union, Nabha
3. Dr. R. D. Rege, Agricultural Adviser, C/o Messrs Perry & Co. Post Box No. 12, Madras
4. Dr. D. A. Gadkary, Joint Director of Agriculture (Engineering) Bombay State, Bombay
5. Shri H. R. Saini, Director of Agriculture, Punjab, Simla (*Chairman*)
6. Dr. H. R. Arakeri, Sugarcane Specialist, Sugarcane Research Scheme Padagaon Posinera, R. S. Dist. Poona.
7. Dr. R. Sankaran Deputy Secretary, Indian Central Cotton Committee 14-Nicol Road, Bombay.
8. Dr. K. J. Kalamkar, Additional Director of Agricultural Commissioner with the Government of India, New Delhi.
9. L. A. Ramdas, Deputy Director General, Meteorological Observatories, (Climatology and Geophysics), Poona
10. Shri B. S. Sawhney, Economic Botanist (Millets)-*cum*-Principal, Government Agricultural College, Ludhiana (E. P.)
11. Shri P. L. Patel, Head of the Agronomy & Plant Breeding Section Institute of Agriculture Anand, Bombay State
12. Dr. L. C. Sikka, Milk Commissioner, *cum*-Administrator, Wikes Building, West Bengal, Calcutta
13. Dr. N. D. Kehar, Head of the Division of the Animal Nutrition, Indian Veterinary Research Institute, Izatnagar
14. Shri N. P. Mohan, Chief Conservator of Forests, Punjab, Simla-2

Ex-officio members

1. Dr. P. C. Rahoja, Head of the Division of Agronomy, Indian Agricultural Research Institute, New Delhi
2. R. V. Ramiah, Head of the Division of Agricultural Engineering, Indian Agricultural Research Institute, New Delhi

SOIL SCIENCE COMMITTEE

Subject : Soils, Agricultural Chemistry, Bio-chemistry, etc.

1. Dr. P. K. Dey, Principal and Professor of Chemistry, College of Agriculture, Rani Kutir, West Bengal, Calcutta-40
2. Dr. J. A. Daji, Additional Assistant Agricultural Commissioner with the Government of India, New Delhi
3. Dr. H. N. Mukerjee, Principal Ranchi Agricultural College, P. O. Kanke, Ranchi, Bihar
4. Dr. J. K. Basu, Director of Soil Conservation (Agriculture) Central Soil Conservation Board Ministry of Food & Agriculture, New Delhi

APPENDIX XV—*Contd.*

5. Dr. V. Subramanyan, Director, Central Food Technological Research Institute, Mysore
6. Dr. B. L. Uppal, Assistant Director (Soil), Central Road Research Institute, Mysore
7. Dr. B. K. Mukerjee, Director, Indian Institute of Sugarcane Research, Rai Bareilly, P. O. Dilkusha, Lucknow
8. Dr. T. R. Sheshadri, Professor of Chemistry and Head of the Department of Chemistry, Delhi University, Delhi
9. Shri M. Sanyasi Raju, Agricultural Chemist (Retd.), Andhra State 3/772, Labtha Colony, Waltair R. S.
10. Dr. N. Narayana, Agricultural Chemist to Government of Bombay, Poona
11. Dr. B. Viswa Nath, 8/85, Western Extension Area, Karol Bagh, New Delhi (*Chairman*)
12. Dr. Sukh Dayal, Agricultural Chemist, Punjab Agricultural College Ludhiana

Ex-officio members

1. Dr. R. C. Hoon, Deputy Director Central Water and Power Commission (Flood Wing) Bikaner House, New Delhi
2. Dr. S. P. Rai Chaudhury, Head of the Division of Chemistry, Indian Agricultural Research Institute, New Delhi
3. Shri R. P. Talat, Compost and Sewage Development Officer, Ministry of Food and Agriculture, Government of India, New Delhi
4. Shri R. S. Gupta, Soil Chemist, Silviculture Branch, Forest Research Institute, Dehra Dun

Animal Husbandry Side

ANIMAL BREEDING COMMITTEE

Subject : All aspects of Animal Breeding

1. Shri S.K. Sen, Additional Director of Animal Husbandry, Bihar, Patna
2. Shri D. Pattabhiraman, Deputy Director of Animal Husbandry (Livestock), Madras, P.O. Triplicane, Madras
3. Dr. R. L. Kaura, Cattle Utilisation Adviser to the Government of India, Ministry of Food and Agriculture, New Delhi
4. Shri G. B. Singh, Director of Animal Husbandry and Veterinary Services, Orissa, Cuttack
5. Dr. P. Bhattacharya, Head of the Division of Animal Genetics, Indian Veterinary Research Institute, Izatnagar
6. Dr. M. D. Patel, Director Institute of Agriculture, Anand
7. Shri B. N. Handa, Animal Husbandry and Warden of Fisheries, Punjab, Simla
8. Dr. P. M. Narainaswamy Naidu, Deputy Animal Husbandry Commissioner with the Government of India, New Delhi
9. Shri V. L. Vazir, Director, Veterinary Department, Jammu and Kashmir, Srinagar

APPENDIX XV—*Contd.*

10. Shri S. G. Iyer, Head of the Division of Poultry, Indian Veterinary Research Institute, Izatnagar
11. Shri R. B. Singh, Animal Geneticist, Livestock Research Station, Mathura
12. Col. H. K. Mehra, Director of Veterinary and Animal Husbandry Services, Madhya Bharat, Gwalior
13. Dr. T. J. Mirchandani, Joint Director, Soil Conservation Department, Damodar Valley Corporation, Hazari Bagh, Bihar
14. Shri J. D. Sampat Kumaran, Research Officer, Division of Animal Genetics, Indian Veterinary Research Institute, Izatnagar
15. Shri S. S. Khot, Livestock Expert to the Government, Bombay State, Poona

Ex-officio Members

Officers of the Council

Shri P. N. Nanda, Animal Husbandry Commissioner with the Government of India, New Delhi (*Chairman*)

DAIRY SCIENCE COMMITTEE

Subject : All aspects of Dairy Science

1. Dr. Z. R. Kothavalla, No. 8, All Askar Road Bangalore.
2. Shri G. S. Godbole, Dairy Development Officer, Bombay State, Poona
3. Shri N. K. Bharagava, Dairy Development Officer, Co-operative Department, Government of U. P., Lucknow
4. Shri D. N. Khurody, Milk Commissioner, Wakefield House, Bailard Estate, Fort, Bombay.
5. Dr. L. C. Sikua Milk Commissioner-cum-Administrator, Haringhata Centre, Government of West Bengal, Writer's Buildings, Calcutta.
6. Shri Chandra Bhan Singh, Superintendent, Machinised State Farm U. P., Fyzabad Road, Lucknow
7. Sardar Santokh Singh, Officer on Special Duty (Agri.) Planning Commission
8. Shri V. Kuriean, Manager, Kaira District, Co-operative Milk Producers Union, Ltd., Anand
9. Major T. Murari, Director of Animal Husbandry, Andhra, Madras—8
10. Professor James N. Warner, Head of the Dairy Department, Allahabad Agricultural Institute, Allahabad

Members by Designation

11. Dr. S. K. Sed, Director, National Dairy Research Institute, Bangalore (*Chairman*)
12. The Director of Remaunts Veterinary and Farms, Q.M.G.'s Branch Army Head Quarters, New Delhi.
13. The Deputy Director of Animal Husbandry Madras State, P. O. Triplicane, Madras

APPENDIX XV—*Contd.*

14. The Deputy Dairy Development Adviser to the Government of India, Ministry of Food and Agriculture, New Delhi
15. The Secretary, Central Council of Gosamvardhana, Ministry of Food and Agriculture, New Delhi
16. The Dairy Husbandry Officer, National Dairy Research Institute, Bangalore.
17. The Dairy Chemist, National Dairy Research Institute, Bangalore
18. The Dairy Technologist, National Dairy Research Institute, Karnal
19. The Dairy Bacteriologist, National Dairy Research Institute, Bangalore

Ex-officio Members

Officers of the Council

ANIMAL NUTRITION COMMITTEE

Subject: ALL ASPECT OF ANIMAL NUTRITION

1. Dr. N.D. Kehar, Head of the Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar (*Chairman*)
2. Dr. K.C. Sen, Director, National Dairy Research Institute, New Delhi
3. Shri V. Mahadevan, Professor of Animal Nutrition, Madras Veterinary College, Madras—7
4. Dr. Lal Chand Dharmani, Retired Agricultural Chemist, Anandpur-Sahib, *via* Sirhind, Rupar (N. Railway)
5. Dr. S.K. Talpatra, Professor of Animal Nutrition, U.P. College of Veterinary Science, and Animal Husbandry, Mathura
6. Shri P.M. Dabadgao, Assistant Agrostologist, Indian Agricultural Research Institute, New Delhi
7. Shri H.R. Saini, Director of Agriculture, Punjab, Chandigarh
8. Shri B.K. Das, Physiological Chemist, Veterinary Department, Assam Gauhati
9. Dr. V. N. Patwardhan, Director, Nutrition Research Laboratory, Coonoor, South India

Members by Designation

10. Shri V.S. Krishnaswamy, Central Silviculturist, Forest Research Institute, Dehra Dun
11. Dr. M. L. Mathur, Officer-in-charge, Southern Regional Nutrition Centre, National Dairy Research Institute, Bangalore
12. Dr. Balkrishna Mohanlal Patel, R.O. Officer-in-charge, Anand Regional Animal Nutrition Research Centre, Institute of Agriculture, Anand
13. Shri S.S. Khot, Livestock Expert to Government, Bombay State, Poona
14. Shri L. Sahai, Director, Indian Veterinary Research Institute, Izatnagar

APPENDIX XV—*Contd.*

15. Dr. Radhaballav Chanda, the Officer-in-charge, Eastern Regional Nutritional Centre, Haringhatta Farm, Calcutta

Ex-officio Members

Officers of the Council

ANIMAL DISEASES AND PESTS COMMITTEE

Subject : Pathology, Parsitology, Toxicology, Pharmaceutics, Physiology, Medicine, Surgery, etc.

1. Shri V. R. Rajagopalan, Director of Animal Husbandry, Madras State, P.O. Triplicane, Madras—5
2. Shri S.R. Chadha, Director of Veterinary Services, Bombay State, Poona-2
3. Shri M.Y. Mangrulkar, Principal, Madhya Pradesh Veterinary College, Jabbalpore
4. Dr. G.S. Thanar, Mahatma Gandhi Marg, Lucknow
5. Shri M.I. Malik, Director of Animal Husbandry, Bihar, Patna
6. Lt. Col. D.P. Sahni, Assistant Director of Remounts, Veterinary and Farms, Q.M.G.'s Branch, Army Headquarters, New Delhi
7. Dr. H.D. Srivastava, Research Officer (Helminthology), Indian Veterinary Research Institute, Izatnagar
8. Shri M. R. Dhanda, Head of the Division of Bacteriology and pathology, Indian Veterinary Research Institute, Mukteswar
9. Shri K.S. Shetty, Director, Veterinary, Hyderabad State, Hyderabad-Deccan
10. Dr. H.N. Ray, Professor of Protozoology, School of Tropical Medicine, Chittaranjan Avenue, Calcutta-12
11. Dr. C. Krishan Rao, Deputy Director of Animal Husbandry, Andhra State, No. 1, Casa Major Road, Egmore, Madras-8
12. Dr. S. Datta, Director of Veterinary Service and Animal Husbandry, West Bengal, Calcutta
13. Major J.M. Lahiri, Joint Director of Veterinary Services & Animal Husbandry, West Bengal, Calcutta
14. Shri G. S. Rathore, Deputy Director of Agriculture (Veterinary) Rajasthan, Jodhpur

Members by Designation

15. Shri L. Sahai, Director, Indian Veterinary Research Institute, Izatnagar (*Chairman*)
16. The Research Officer (Entomology), Indian Veterinary Research Institute, Izatnagar

Ex-officio Members

Officers of the Council

APPENDIX XV—*Contd.*

STATISTICAL COMMITTEE

Subject : All aspects

1. Dr. R. J. Kalamkar, Additional Agricultural Commissioner with the Government of India, New Delhi
2. Shri R.S. Koshal, Statistician, Department of Agriculture, Bombay State, Poona-5
3. Dr. K. Kishan, Chief Statistician to the Government of India, Department of Agriculture, Chhota Chuller Manzul, Lucknow
4. Dr. K. R. Nair, Statistician, Forest Research Institute, and College P.O. New Forest, Dehra Dun
5. Professor V.D. Thawani, Professor of Statistics, Gauhati University, Gauhati
6. Dr. N. S. R. Sastry, Director of Statistics, Reserve Bank of India Bombay
7. Shri M.V. Dovotia, Director of Statistics, Government of Hyderabad, Hyderabad-Deccan
8. Dr. C. R. Rao, Professor and Head of the Division of Research and Training, Indian Statistical Institute, 203, Barrackpore Trunk Road, Calcutta-35

Ex-officio Members

1. Dr V .G. Panse, Statistical Advisor, Indian Council of Agricultural Research, New Delhi (*Chairman*)
2. The Economic and Statistical Advisor, Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India New Delhi
3. The Joint Director, Central Statistical Organization, New Delhi

AGRICULTURAL ECONOMICS COMMITTEE

Subject : Agro-economics problems

1. Shri Manilal B. Nanavati, President, Indian Society of Agricultural Economics, Bombay (*Chairman*)
2. The Agricultural Commissioner with the Government of India, Indian Council of Agricultural Research, New Delhi
3. Dr G. D. Aggarwal, Agricultural Economist to the Government of U.P. and Professor, Agricultural College, Kanpur
4. The Economic and Statistical Advisor, Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, New Delhi
5. Prof. J. J. Anjaria, Economic Advisor, Department of Economic Affairs, Ministry of Finance, Government of India, New Delhi

APPENDIX XV—*Contd.*

6. Prof. C. N. Vakil, Director, School of Economics and Sociology, University of Bombay, Bombay
7. Prof. D.G. Karve, Summer Queen, Arthur Bunder Road, Colaba, Bombay-5
8. Prof. D. R. Gadgil, Director, Gokhale Institute of Economics and Sociology, Poona
9. Dr. J. P. Niyogi, University Prof. of Economics and Head of the Department of Economics, University of Calcutta, University College of Arts and Commerce, Ashutosh Building, Calcutta
10. Dr. V. K. R. V. Rao, Director, Delhi School of Economics, University of Delhi, Delhi
11. Statistical Adviser, Indian Council of Agricultural Research, New Delhi
12. Dr. M.B. Ghatge, Agricultural Marketing Adviser to the Government of India, Ministry of Food and Agriculture, New Delhi
13. The Secretary, Research Programme Committee, Planning Commission, New Delhi
14. Shri M.L. Dantawala, Section of Agricultural Economics, University of Bombay, Bombay

PUBLICATION COMMITTEE

Subject : Publication and Publicity

1. The Vice President, Indian Council of Agricultural Research, New Delhi (*Chairman*)
2. The Agricultural Commissioner, with the Government of India, New Delhi
3. The Animal Husbandry Commissioner with the Government of India, New Delhi
4. The Director, Indian Agricultural Research Institute, New Delhi
5. The Director, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh
6. The Director, National Dairy Research Institute, Bangalore
7. The Plant Protection Adviser to the Government of India, Directorate of P.P.Q. & S., Ministry of Food and Agriculture, New Delhi
8. Dr. S. B. Singh, Director of Agriculture, Uttar Pradesh, Lucknow
9. Shri V. R. Rajagopalan, Director of Animal Husbandry, Madras

APPENDIX XV—*Contd.*

10. Dr. A. C. Joshi, Deputy Director, Punjab Education Department, Chandigarh
11. The Director of Publicity, Ministry of Food & Agriculture, Government of India, New Delhi
12. The Secretary, Indian Council of Agricultural Research, New Delhi
13. The Editor, Indian Council of Agricultural Research, New Delhi
14. The Agricultural Marketing Adviser to the Government of India, Directorate of Marketing and Inspection, New Delhi

COMMODITY COMMITTEES

Agriculture Side

FOODGRAINS COMMITTEE

1. Shri M. S. Randhawa, Vice President, Indian Council of Agricultural Research, New Delhi (*Chairman*)
2. Shri Damodar Vaman Potdar, 180, Shanwar Peth, Poona-2
3. Shri Ashutosh Bhattacharya, Bengal Rice Mills and Merchants, Association, 30, Kabir Road, Calcutta
4. Captain Dalipman Singh, Advocate and Chairman, District Co-operative Bank, Ltd., Ramniwas, Fatehpur, Uttar Pradesh
5. Shri J. S. Rayan, Registrar of Co-operative Societies, Madras
6. Sardar Iqbal Singh, P.O. Aira Estate, Kheri District, Uttar Pradesh
7. Dr. V. N. Patwardhan, Director, Nutrition Research Laboratories, Coonoor, South India
8. Shri V.K. Ramaswamy Mudaliar, M.L.A., Choyyur, Madurantakam Taluk, Chinglepet District, Madras

Members by Designation

1. The Director, Central Rice Research Institute, Cuttack
2. The Director of Agriculture, Madhya Bharat, Gwalior
3. The Director of Agriculture, Rajasthan, Jaipur
4. Shri K.R. Sontakhey, Director of Storage and Inspection, Directorate General of Food, Ministry of Food and Agriculture, Government of India, New Delhi
5. Officers of the Council

APPENDIX XV—*Contd.*

LIST OF MEMBERS OF THE CENTRAL SPICES AND CASHEWNUT COMMITTEE

1. Dr. B.N. Uppal, Agricultural Commissioner with the Government of India (*Chairman*)
2. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi
3. Dr. K.C. Naik, Deputy Director of Agriculture (Headquarters), Madras State, Madras
4. Dr. M. B. Ghatge, Agricultural Marketing Adviser to the Government of India, New Delhi
5. Shri S.V.R. Chari, Under Secretary, Ministry of Commerce and Industry, Government of India, New Delhi
6. Director of Agriculture, Travancore-Cochin, Trivandrum
7. Deputy Director of Agriculture, Mysore State, Bangalore
8. Shri N. C. Ray, Joint Director of Agriculture(Marketing), West Bengal Writers Buildings, Calcutta
9. Shri K.V. Thomas, Sea View Estate, Mundakayam, Travancore-Cochin
10. Shri M., C/o Messrs. Makkar Pillai and Sons, Alwaye, Travancore-Cochin
11. Shri K. N.P. Zantye, Malvan, District Ratnagiri, Bombay State
12. Shri S. Narasapaya, B. A., B.L., Member Legislative Council, Mangalore-3, Madras State
13. Shri A. Karunakara Menon, Ambalakat, Chelupuram, Kozhikode, Madras State (Co-opted member)

Animal Husbandry Side

HIDES AND SKINS COMMITTEE

1. Janab M. J. Jamal Mohideen Saheb, 16, Thambu Chetti Street, Madras-1
2. Shri A. M. Das, Director, Central Leather Research Institute, Madras
3. Shri Radho Krishen Mirza, C/o The Kashmir Export Company, Dalgate, Srinagar
4. Shri T. Jiyar Das, Vice President, All-India Depressed Classes League, 25, Ramanam Road, Madras-1
5. The Chairman, Calcutta Hides and Skins Shippers Association, Royal Exchange, Post Box No. 280, Calcutta 1
6. Shri B. N. Soni, Research Officer, Indian Veterinary Research Institute, Izatnagar

Members by Designation

1. Shri L. Sahai, Director, Indian Veterinary Research Institute, Izatnagar (*Chairman*)
2. Shri R. F. Carbey, Vice Chairman, The Tanners Federation of India C/o the British India Corporation Ltd. Cooper Allen Branch, Civil Lines, Kanpur

APPENDIX XV—*Contd.*

3. The Principal, Institute of Leather Technology, Madras
4. The Head of the Division of Parasitology, Indian Veterinary Research Institute Izatnagar
5. Shri P. C. Basu, Development Officer (Leather) Development Wing Ministry of Commerce and Industry, Government of India, Shah jehan Road, New Delhi
6. The Agricultural Marketing Adviser to the Government of India
7. Officers of the Council

WOOL COMMITTEE

1. Shri S. S. Khot, Livestock Expert to Government, Bombay State, Poona
2. Dr. S. Nanjundayya, Director, Technological Laboratory, Indian Central Cotton Committee, Matunga Bombay
3. Shri B. K. Vaidya, Assistant Director, Textile Research Institute, Ahmedabad Textile Industry's Research Association, Ahmedabad
4. Shri Bhuh Cishore Sinna, 64/58 Western Extension Area, Karol Bagh New Delhi
5. Shri P. V. Kanetkar, Sanchalak, All India Spinners Association Kashmir Branch, Srinagar, Jammu and Kashmir
6. Shri Jugraj Sethia, Woollen Press Building, Bikaner
7. Shri Saratchandra Maheshwari, Honorary Secretary, the All India Wool Traders Federation, Post Box No. 1051, Bombay-1
8. Shri N. L. Narayan, Deputy Director, Sheep and Wool, Rajasthan Bikaner
9. Shri Mannobhai Doongursee, C/o Doongursee and Sons, Maneckji Wadia Building, 127, Mahatma Gandhi Road, Fort, Bombay
10. Shri H. K. Lall, Deputy Director of Animal Husbandry, Meerut Circle, Meerut (*Chairman*)
11. Sardar Gurbax Singh Mahal, Research Officer, Sheep Breeding Station, Government Cattle Farm, Hissar
12. Shri E.B. Whitley, Director International Wool Secretariat, Connaught Place, New Delhi

Members by Designation

1. Shri S.A. Teckchandani, Under Secretary to the Government of India, Ministry of Commerce and Industry, Government of India, New Delhi
2. The Agricultural Marketing Adviser to the Government of India, New Delhi
3. The Director, Indian Standards Institution, Delhi
4. Officers of the Indian Council of Agricultural Research

APPENDIX

Annual accounts of Income and Expenditure of the

RECEIPTS

Head of Account	Receipts during the year	Total Receipts
	Rs. A. P.	Rs. A. P.
OPENING BALANCE		
Cash balance	3,099 13 9	
Bank balance	18,64,249 7 3	
Provident fund	86,402 3 9	
	19,53,751 8 9	19,53,751 8 9
I. Receipts under the Agricultural Produce Cess Act		49,12,413 10 0
II. Contributions and grants :—		
(a) from constituent States :		
(i) Jammu & Kashmir	5,000 0 0	
(ii) Hyderabad Deccan	5,000 0 0	
(iii) Madras	5,000 0 0	
(iv) Travancore-Cochin	5,000 0 0	
(v) Coorg, Mercara	15,000 0 0	
(vi) Saurashtra	30,000 0 0	
	65,000 0 0	65,000 0 0
(b) From Central Government and Ford-Foundation for :		
(i) Research & Development of Pepper, Cashew- nut, etc.	24,860 0 0	
(ii) Improvement of Land Records and Agri. Sta- tistics	9,520 0 0	
(iii) Sample survey for the estimation of area and yield of pepper	49,880 0 0	
(iv) Improvement of Fisheries & Livestock Stati- stics	53,000 0 0	
(v) Improvement of Land Records and Agri. Sta- tistics	8,120 0 0	

XVI

Indian Council of Agricultural Research for the years 1955-56

PAYMENTS

GRANTS		Head of Account	Expenditure during the year	Excess (-) or savings (+) over net grant	REMARKS
Original	Net				
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
		A. Standing Charges :			
1,00,000	87,900	1. Accounts & Audit	88,610 12 0	(-)710 12 0	(a) Incon-
9,000	2,600	2. Travelling allowance of non-official members of the Council	3,422 1 0	(-)828 1 0	siderable. (a).
25,000	16,800	3. Travelling allowance of members of the Advisory Board and other persons invited to attend the meeting.	16,642 9 0	(+)157 7 0	(a).
2,000	500	4. T. A. of non-official members of the Board of Agricultural and A. H. in India	457 2 0	(+) 42-13-0	(a).
..	3,200	5. Miscellaneous	3,522 2 9	(+)323 2 9	(a)
65,100	70,000	6. Editorial staff for Indian Farming	49,332 8 0	(+)667 8 0	(a).
..	12,900	7. Subsidies to various Journals	12,829 0 0	(+)71 0 0	(a).
1,27,000	1,00,600	8. Integrated Statistical Scheme	1,00,436 5 3	(+)163 10 9	(a).
..	200	9. Publication of abstracts from Indian Journal of Veterinary Science	191 8 0	(+)8 8 0	(a).
..	92,800	10. Publicity Scheme	92,483 13 3	(+)316 2 9	(a).

1	2	3
(b) From Central Government and Ford Foundation-- <i>Contd.</i>		
(vi) Study of milk yield breeds and management practices of bovines in the northern region of India	39,000 0 0 1,84,380 0 0	
(vii) The Publication of a Journal for village workers	55,500 0 0	
(viii) Establishment of a research station for pepper	50,000 0 0	
(ix) Research and development of pepper and cashewnuts, etc.	3,925 0 0	
(2) Crop-cutting survey on sugarcane	37,900 0 0	
(xi) The development of pepper, Madras	76,000 0 0	
(xii) Composite research Station for black pepper, cashewnuts etc.	15,000 0 0	
(xiii) Experiments on Indian Farm Youth Exchange	2,314 0 0	
(xiv) International Farm Youth exchange programme	3,800 0 0	

XVI—Contd.

4	5	6	7	8	9
..	8,600	11. Publication of a quarterly <i>Rice News Teller</i>	8,482 5 6	(+)117 9 6	(a).
..	40,500	12. Publication of the <i>Dharti-ke-lal</i>	39,952 6 6	(+)547 9 0	(a).
..	5,000	13. Setting up of a Central Film Library	4,921 7 0	()78 9 0	(a).
..	24,900	14. Press Section	24,704 12 6	(-)193 3 6	(a).
..	18,700	15. Printing of different series of publications issued by the Council	18,595 13 6	(+)204 2 6	(a).
..	41,400	16. Printing of hand-book series of the council	40,934 10 0	(+)465 6 0	(a).
..	34,500	17. Establishment of a Central Distribution Section, for the publication of the Council	34,304 2 9	(+)195 8 3	(a).
..	14,900	18. Farm news and Press releases	14,650 5 3	(+)249 10 9	(a).
..	12,000	19. Abstraction or horticultural literatures	11,893 6 6	(+)106 9 6	(a).
..	..	B-Research training and publicity under direct control of I. C. A. R.	..	..	..
..	400	20. Experiments on Katka phosphate and calcium phosphatae	314 10 0	(+)85 6 0	(a).
2700	52,800	21. Co-ordinated pasture land-Grassland Survey Scheme	54,205 10 0	(-)1,405 10 0	(a).
..	400	22. Supplement to Monograph on the Fungi of India	352 12 3	(+)47 3 9	(a).
..	8,100	23. Grape show, Hyderabad	8,079 2 0	(+)20 14 0	(a).
19,300	17,500	24. Description of different varieties of fruit	17,174 7 3	(+)325 8 9	(a).

1	2	3
(xv) Weed Control Scheme	32,200 0 0	
(xvi) Improvement of Fisheries and Livestock Statistics	65,000 0 0	
(xvii) Organisation of Agri. Exhibition at Colombo	2,23,500 0 0	
(xviii) Manurial trials	56,100 0 0	
(xix) Publicity of Japanese Method of paddy cultivation	45,000 0 0	
(xx) Establishment of Res. Station for Cardamom	13,000 0 0	
(xxi) Cattle Sterility	1,23,500 0 0	
(xxii) Research and development of pepper and cashewnuts, etc.	2,080 0 0	
(c) From other sources :— Indian Central Sugar-cane Committee	9,89,199 0 0 1,000 0 0	9,89,199 0 0 1,000 0 0
(III) Interest from Investments :		
(1) Interest on S. B. Account No. 48041	664 0 0	
(2) Interest on 3½% National Plan Loan, 1964	645 10 0	
(3) 2½% Loan of 1953	39,827 8 0	
(i) 2½% loan 1962	26,059 8 0	
(ii) 3% loan 1963-65	49,361 4 0	
(iii) 3% 2nd Victory 1959-61	14,962 8 0	

XVI—Contd.

4	5	6	7	8	9
	1,500	25. Grassland expert the F. A. O.	1,436 3 0	(+)63 13 0	(a).
530	4,800	26. Co-ordinated wheat rust control scheme	4,721 5 0	(+)78 11 0	(a).
..	100	27. Spices enquiry Committee	27 2 0	(+)72 14 0	(a).
..	500	28. Monograph on me- chanical cultivation in India	500 0 0	..	
33,000	19,900	29. Co-ordination of Research	19,467 0 9	(+)432 15 3	(a) Incon- siderable.
..	1,600	30. Commercial produc- tion of hybrid maize	1,516 0 0	(+)84 0 0	(a).
..	300	31. Award of a prize or soil moisture de- terminer	294 0 0	(+)6 0 0	(a).
..	3,000	32. Survey of indigen- ous agricultural im- plements	3,139 11 0	(-)139 11 0	(a).
..	21,300	33. Agronomic experi- ments and manurial experiments (ii) <i>Animal Husbandry</i>	21,152 6 0	(+)147 10 0	(a).
..	11,00	34. Monograph on 'Ch- emotherapy of ani- mal trypano somiasis'	1,009 2 3	(+)90 13 9	(a).
50,000	47,800	35. Cost of milk pro- duction	47,470 14 9	(+)323 1 3	(a).
..	..	..	..	..	
..	..	..	..	..	
2,000	..	..	..	..	
..	..	..	..	..	
8,600	46,000	36. Cattle Sterility	4,478 20	(+)121 12 0	(a).
3,000	35,100	37. Expansion of Cen- tral Handbook Sec- tion	34,940 14 0	(+)159 2 0	

1	2	3
	Rs. A. P.	Rs. A P.
(iv) 3% Victory loan 1957	55,546 12 0	
(v) 3% loan, 1970-75	1,89,808 12 0	
(vi) 3½% Government National Plan Bonds 1961	35,310 8 0	
(vii) Fixed Deposits etc.	4,880 13 0	4,16,067 3 0
IV. Miscellaneous Receipts :		
(i) Receipts realised from Schemes	35,777 13 6	
(ii) Receipts on account of unspent balances of grants made by the Council	16,763 2 0	
(iii) Miscellaneous	5,57,801 6 3	
Total Miscellaneous Receipts	6,10,342 5 9	
V. Debts & Remittances :		
(i) Loan and Advances		
(1) Refund of cycle advance	3,225 6 0	
(2) Refund of motor cycle advance	354 5 0	
(3) Refund of motor car advance	678 0 0	
	4,257 11 0	4,257 11 0
(ii) Deposits and advances repayable	52,886 1 2	
(a) Subscription		
(b) Repayment of advances from subscription	2,454 0 0	

XVI—Contd.

4	5	6	7	8	9
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
24,000	..		..	..	(a)
..	..		..	..	
..	320	38. Training centre for experimental designs in Agri. and A. H.	167 5 6	(+)132 10 6	(a).
..	800	39. Assignment of Sheep and Wool Expert of the F. A. O.	776 13	(+)23 2 6	(a).
..	300	40. Printing of handbook of Statistics for the use of Agri. Research Workers	238 1 6	(+)61 14 6	(a) Inconsiderable.
81,300	36,600	41. National Index of Field Experts	36,356 10 6	(+)243 5 6	(a).
7,200	2,900	42. Award of fellowships to the diploma course Students in Agri. Statistics.	2,821 0 0	(+)79 0 0	(a).
..	13,400	43. Potentialities of Indian Village cattle for increased milk production through better feeding and management.	13,240 4 6	(+)159 11 6	(a).
1,750	2,800	45. Award of fellowship in Dairying I.D.R.I.	2,800 0 0	..	
4,140	8,200	46. Training course in livestock marketing	8,110 0 0	(+)90 0 0	
..	..		..	..	
..	..		..	..	
10,050	42,600	47. Camel Breeding, I.C.A.R.	42,577 1 6	(+)22 14 6	(a).
24,430	34,200	48. Award of fellowship in A.H. subjects I.C.A.R.	34,183 0 0	(+)17 0 0	(a)

APPENDIX

1	2	3
	Rs. A. P.	Rs. A. P.
(c) Interest on advances	155 13 0	
(d) Council's contribution	6,071 11 6	
(e) Laps and forfeiture	..	
(f) Interest from Investment, etc.	645 10 0	
(g) Permanent advances	62,213 3 8 400 0 0	62,213 3 8
(h) Suspense	453 0 0	
(i) Other deposits and advances repayable	(—)27,584 14 0	(—)26,691 14 0
(iii) Recoveries from Research staff on account of Income-tax, provident fund etc.		
(a) Income Tax	4,073 7 0	
(b) G.P. Fund	6,386 13 0	
(c) Mix. Recoveries	5,119 7 0	
(d) Contributory Provident Fund	6,721 0 0	
	22,360 11 0	22,360 11 0
Total Receipts and Opening balance	..	90,09,913 7 2
Investment and Reinvestment	..	22,97,100 0 0
		1,13,07013 27 0

XVI—Contd.

4	5	6	7	8	9
		(iii) <i>Miscellaneous</i>			
33,000	22,207	49. Library.	22,025 15 3	(+)174 0 9	(a)
..	..			..	..
1,91,770	1,06,900	50. Integrated publicity work	1,06,781 12 0	(+)118 4 0	(a)
1,610	900	51. Stat. analysis of data collected in breeding schemes at I.D.R.I.	897 12 0	(+)2 4 0	(a)
..	100	52. Compilation of the Agriculture and Animal Husbandry in India.	50 8 0	(+)49 8 0	(a)
..	1,11,000	53. Building of the I.C.A.R.	1,10,773 4 3	(+)226 11 9	(a)
40,000	29,900	54. Indian Council of Agricultural and Veterinary education.	29,823 6 0	(+)76 10 0	(a)
..	1,000	55. Appointment of Shri J. Malcalm Orchard under point four programmes.	897 11 0	(+)102 5 0	(a)
..	1,000			..	
..	6,900	56. International farm youth exchange.	6,873 15 0	(+)26 1 0	(a)
..	9,000	57. Silver Jubilee celebrations of council.	8,901 4 9	(+)98 11 3	(a)
..	1,300	58. Crop cutting experiments of jute	1,266 5 0	(+)33 11 0	(a)
..	4,200	59. Duplicating Section.	4,141 15 6	(+)58 0 5	(a)
..	2,900	60. Village projects, Delhi.	2,874 0 0	(+)26 0 0	(a)
..	11,100	61. Printing of an Album of Indian Agriculture and Animal Husbandry	10,993 7 3	(+)106 8 9	(a)
..	9,100	62. Japanese method of paddy cultivation.	9,045 3 0	(+)54 13 0	(a)
..	25,400	63. Livestock and fishery statistics	25,291 3 0	(+)108 13 0	(a)
..	1,19,600	64. Ceylon and Amritsar exhibitions	1,16,494 6 0	3,105 10 0	(a)

APPENDIX XVI—Contd.

PAYMENTS

GRANTS		Head of the Account	Expenditure during the year	Excess (—) or Saving (+) over net grant	REMARKS
Original	Net				
1	2	3	4	5	6
Rs.	Rs.		Rs. A.P.	Rs. A.P.	
..	..	(iii) <i>Miscellaneous Contd.</i>			(a) Incon- siderable.
1,00,000	3,07,500	65. Delhi Milk Supply	3,07,490 0 6	(+)9 15 6	(a)
..	1,000	66. Publication of Dharti-ke-lal in regional languages.	1,000 0 0	..	
..	3,200	67. Publication of extension news letter for extension workers.	3,119 3 0	(+)80 13 0	(a)
..	2,93,700	68. Building of the I.C.A.R. (Statistical Wing).	2,94,808 9 3	(—)108 8 3	(a)
..	88,400	69. Setting up of a Farmers farm in the country,	88,311 5 0	(+)88 11 0	(a)
..	21,800	70. Preparation of reviews on research work done in India in the field of agriculture and animal Husbandry.	21,631 14 3	(+)166 1 9	(a)
..	2,400	71. Pepsu Exhibition	2,347 12 9	(+)52 3 3	(a)
..	2,100	72. Fellowship Res. Agri. & A.N.	2,012 6 0	(+)87 10 0	(a)
..	400	73. Artificial insemination Scheme.	41 9 0	(+)358 7 0	(a)
..	5,400	74. Conference of Workers on Millets, Kolapur,	5,232 3 6	(+)167 12 6	(a)
..	1,900	75. Research Fellowship in Agri. & A.N. Services	1,794 0 0	(+)106 0 0	(a)
..	..	76. Preparation of monographs on Poisonous Plants of India.	200 0 0	(—)200 0 0	(a)
		Pt. II-New Schemes (A) Research under direct control of the I.C.A.R.			

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
..	3,800	77. Appointment of Liaison Officer for Sheep & Wool Schemes.	3,707 1 0	(+)92 15 0	(a) A.H. Head Quarters
..	17,200	78. All India Mango shows.	17,093 7 0	(+)106 9 0	(a) Agri Hd. Qr.
..	17,900	79. Sugarcane Production.	17,693 15 0	(+)206 1 0	(a) Misc. Hd. Qr.
..	10,200	80. Study of Milk 'yield' breeds and management practices of bovines.	9,929 1 0	(+) 270 15 0	(a)
..	19,400	81. Training centre of land records.	19,299 1 6	(+)100 14 6	(a)
..	24,300	82. Industrial Exhibition Madras.	24,182 7 3	(+)117 8 9	(a)
..	4,400	83. Pilot Sample Survey Pepper.	4,981 9 0	(-)581 9 0	(a)
..	6,900	84. Publication of agricultural Information news teller.	6,818 0 0	(+)82 0 0	(a)
..	12,700	85. Printing of Kheti.	12,638 4 9	(+)61 11 3	(a)
..	28,700	86. Printing of Extension guides.	28,685 14 9	(+)14 1 3	(a)
..	15,400	87. Printing of Extension books for village workers.	15,263 4 6	(+)136 11 6	(a)
		C—Grant-in-aid (i) Agriculture (a) Rice			
5,100	900	88. Improvement of paddy M.B.	830 0 0	(+)70 0 0	(a) Inconsiderable
4,000	13,400	89. Rice breeding Punjab.	13,320 9 0	(+)79 7 0	(a)
8,400	4,800	90. Rice breeding Coorg.	4,800 0 0	..	
3,100	27,900	91. Usar land paddy, U.P. Survey & Collection of paddy, C. R.R.I.	27,806 0 0	(+)94 0 0	(a)

APPENDIX XVI—*Contd.*

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
5,400	6,500	92. Blast & foot rot diseases of Rice & wheat, Bombay.	6,466 0 0	(+)34 0 0	(a)
4,420	9,300	93. Boro Paddy W. Bengal.	9,240 0 0	(+)60 0 0	(a)
5,600	5,000	94. Breeding salt & flood resistant varieties, Assam.	5,000 0 0	..	
8,400	7,900	95. Breeding salt & flood resistant varieties, Travancore-Cochin.	7,895 13 0	(+)4 3 0	(a)
17,900	10,300	96. Breeding salt & flood resistant varieties, W. Bengal.	11,068 12 0	(-)768 12 0	(x)
7,600	7,600	97. Scheme for work on Rice in saline areas, Andhra.	7,581 12 0	(+)18 4 0	(a)
..	1,000	98. Japanese Method of Rice in cultivation, Coorg.	1,000 0 0	..	
..	1,100	99. Japanese method of Rice cultivation, Mysore.	1,027 0 0	(+)73 0 0	(a)
..	1,800	100. Japanese method of Rice cultivation, Orissa.	1,780 0 0	(+)20 0 0	(a)
..	1,200	101. Japanese method of Rice cultivation, W. Bengal.	1,180 0 0	(+)20 0 0	(a)
..	2,600	102. Japanese method of Rice cultivation, Bihar.	2,600 0 0	..	
..	1,900	103. Japanese method of Rice cultivation, Andhra.	1,810 0 0	(+)90 0 0	(a)
..	1,200	104. Japanese method of Rice cultivation, M.P.	1,150 0 0	(+)50 0 0	(a)
..	..	105. Japanese method of Rice cultivation, U.P.	3,500 0 0	(-)3,500 0 0	(*) x Demand for funds

APPENDIX XVI—*Contd.*

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
..	2,900	106. Japanese method of Rice cultivation, Bombay.	6,416 0 0	(-)3,516 0 0	(x) very late during the year, received
..	1,600	107. Japanese method of Rice cultivation, Madras.	1,510 0 0	(+)90 0 0	(a)
5,100	3,900	108. Physiology of Rice Flowering W. Bengal	3,820 0 0	(+)80 0 0	(a)
6,500	4,300	109. Breeding varieties resistant to piriculan, Madras.	4,285 0 0	(+)15 0 0	(a)
..	..	110. Breeding varieties resistant to piriculan, Andhra.	1,800 0 0	(-)1,800 0 0	(x)
..	..	111. Study on Paddy Agreayzon, Hyderabad.	1,460 0 0	(-)1,460 0 0	(x)
5,000	4,700	112. Rai diseases of paddy, Kashmir.	4,700 0 0	..	
4,700	10,800	113. Manurial experiments on paddy lands W. Bengal.	10,772 3 6	(+)27 12 6	(x)
3,900	5,200	114. Improvement of Hill Paddy, Assam	5,200 0 0	..	
28,600	22,400	115. Increases Rice yield C. R. R. I.	22,348 0 0	(+)52 0 0	(a)
..	20	116. Rice Breeding Schemes Bulsar.	16 0 0	(+)4 0 0	(a)
		(b) <i>Wheat & other Cereals</i>			
5,290	12,000	117. Maize Breeding Punjab.	11,901 8 6	(+)98 7 6	(a)
9,200	7,000	118. Do. U. P.	6,977 0 0	(+)23 0 0	(a)
8,300	6,800	119. Do. Bihar.	6,780 0 0	(+)20 0 0	(a)
14,000	11,600	120. Do. W. Bengal	11,539 7 0	(+)60 9 0	(a)
..	..	121. Do. Almora	1,302 4 0	(-)1,302 4 0	(x)
4,200	2,300	122. Hybrid Corn Seed, Almora.	2,217 9 3	(+)82 6 9	(a)

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
32,000	4,300	123. Improvement of Pastures and legumes I. A. R. I.	4,220 0 0	(+)80 0 0	(a)
5,400	6,200	124. Improvement of Pastures and legumes M. P.	6,200 0 0	..	
12,500	12,100	125. Do. Bombay	12,003 6 3	(+)96 10 0	(a)
6,000	4,500	126. Foot rot of wheat M. P.	4,500 0 0	..	
8,700	8,500	127. Studies on wheat Bombay	8,720 0 0	(+)80 0 0	(a)
2,300	11,900 14,300	128. Wheat Breeding Niphal Bombay Mahableshtar. }	11,865 0 0 14,220 0 0 }	(+)35 0 0 (+)80 0 0 }	(a) (a) }
1,000	19,800	129. Do. M. P.	19,781 6 0	(+)18 10 0	(a)
..	10,100	130. Do. Hyderabad	10,001 10 0	(+)98 6 0	(a)
..	2,000	131. Do. U. P.	2,000 0 0	..	
1,220	5,000	132. Do. Punjab	5,000 0 0	..	
..	400	133. Coordinated wheat rust control scheme (Mycological) Simla Delhi Agra Botany, Delhi Pusa Simla (M.B.)Andore }	328 0 0	(+)72 0 0	(a)
34,100	18,900	134. Maize breeding I. A. R. I.	..	(+)30 0 0	(a)
14,400	13,100	135. Maize Breeding, Hyderabad.	13,063 2 0	(+)30 14 0	(a)
..	2,300	136. Do. Rajasthan	2,300 0 0	..	
840	6,300	137. Do. Pepsu	6,280 0 0	(+)20 0 0	(a)
6,000	5,000	138. Wheat Breeding Rajasthan	5,000 0 0	..	

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
3,500	3,200	139. Barley improve- ment, Rajasthan	3,200 0 0	..	
7,200	3,000	140. Research on fod- der production W. Bengal.	3,000 0 0	..	
6,000	5,000	141. Do. Bihar	5,000 0 0	..	
3,900	3,400	142. Do. Coorg	3,310 0 0	(+)90 0 0	(a)
5,700	5,500	143. Do. Bhopal	5,458 0 0	(+)42 0 0	(a)
		(c) <i>Millets & Pulses</i>			
4,000	1,400	144. Pulse breeding Madhya Bharat, Gwalior.	1,311 2 0	(+)88 14 0	(a)
5,000	2,000	145. Hybrid Bajra Bom- bay.	2,000 0 0	..	
7,300	6,700	146. Striga attack on Sorgham Andhra.	6,700 0 0	..	
12,500	10,300	147. Hybrid combu, Madras.	10,268 13 6	(+)31 2 6	(a)
1,640	990	148. Gram Pests, M.P.	830 0 0	(+)70 0 0	(a)
11,000	7,200	149. Jowar & Bajra bre- eding Saurashtra.	7,180 0 0	(+)20 0 0	(a)
5,700	5,100	150. Pulse Breeding W. Bengal.	5,030 4 3	(+)60 11 9	(a)
5,000	4,600	151. Storage & Viabili- ty of Pollen grains, Delhi University.	4,332 0 0	(+)68 0 0	(a)
		(d) <i>Fruits</i>			
..	100	152. Paylogy of pulses Presidency College Calcutta.	70 12 0	(+)29 4 0	(a)
18,000	1,600	153. Horticulture M.P.	1,544 0 0	(+)56 0 0	(a)
28,200	21,500	154. Do. Hederabad.	21,481 3 6	(+)18 12 6	(a)
10,300	12,000	155. Orange cultivation Coorg.	12,000 0 0	..	
17,700	22,300	156. Banana research Madras.	22,262 12 10	(+)37 3 2	(a)
7,400	6,200	157. Do. Bombay	6,189 0 0	(+)11 0 0	(a)
15,700	13,000	158. Do. West Bengal	12,947 10 6	(+)52 5 6	(a)

APPENDIX XVI—*Contd.*

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
4,000	4,700	159. Citrus Manurial trials Punjab.	4,626 0 0	(+)74 0 0	(a)
11,420	4,400	160. Remidical measures against Sanjose scale Kashmir.	4,309 13 0	(+)93 0 0	(a)
8,500	5,800	161. Chemical Composition and Nutritive value of Fruits and Vegetables, Coonoor.	8,734 0 0	(+)64 0 0	(a)
3,200	7,600	162. Citrust root Stock trials Andhra.	7,511 0 0	(+)89 0 0	(a)
10,000	17,600	163. Investigation of micro Nutrients I.A. R.I.	17530 0 0	(+)70 0 0	(a)
31,000	31,000	164. Citrus die back diseases Coorg.	31,000 0 0	..	
22,600	60,000	165. Date Palm Punjab.	60,000 0 0	..	
4,400	13,900	166. Fruit Research Stations U. P.	13,975 0 0	(—)75 0 0	(a)
..	100	167. Fruit Preservation Assam.	27 14 0	(+)72 2 0	(a)
1,800	100	168. Mycological & Entomological Investigations of fruits, U.P.	71 0 0	(+)29 0 0	(a)
..	6,700	169. Co-ordinated scheme on the effect of chemicals on the storage of fruits & Vegetable C.F.T. R.I.	6,670 0 0	(+)30 0 0	(a)
..	2,700	170. Do. C.P.R.I.	2,680 0 0	(+)20 0 0	(a)
..	2,000	172. Coordinated scheme on the effect of chemicals on the storage of fruits & vegetables M.P.	2,000 0 0	..	
..	4,400	172. Do. U. P.	4,400 0 0	..	
..	5,000	173. Do. Bombay	5,000 0 0	..	
..	3,000	174. Do. Punjab	3,000 0 0	..	

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
3,000	1,900	175. Improvement of Bar fruit V.P.	1,810 0 0	(+)90 0 0	(a)
3,000	6,600	176. Do. Pepsu	2,800 0 0	(+)3,800 0 0	(a)
2,600	2,000	177. Do. M. P.	1,960 0 0	(+)40 0 0	(a)
..	7,400	178. Citrus fruit Research M. P.	7,380 0 0	(+)20 0 0	(a)
..	23,000	179. Fruit Res. M. P.	23,000 0 0	..	
..	97,00	180. Do. Orissa	9,640 0 0	(+)60 0 0	(a)
..	1,700	181. Manual on fruit Res. C. F. T. R. I.	1,690 15 0	(+) 9 1 0	(a)
8,700	7,800	182. Cashewnuts, Madras	7,725 10 6	(+)74 6 6	(a)
5,600	1,600	183. Cashewnuts, Travancore-Cochin.	1,550 10 0	(+)50 0 0	(a)
..	..	184. Improvement of ber fruit trees, Pepsu.	3,800 0 0	(-)-3,800 0 0	(x)
2,000	2,000	185. Fruit preservations M.P.	2,000 0 0	..	
..	600	186. Preparation of a Manual of Fruit culture in India, Punjab.	512 0 0	(+)88 0 0	(a)
		(e) Vegetable			
..	400.	187. Tuber crops, Bombay.	355 0 0	(+)45 0 0	(a)
1,800	100	188. Tuber Crops, Punjab.	10 0 0	(+)90 0 0	(a)
2,300	6,700	189. Tuber crops Bihar	6,700 0 0	..	
4,000	3,500	190. Tuber crops, Orissa.	3,450 0 0	(+)50 0 0	(a)
8,000	5,500	191. Tuber crops, Madras.	5,410 0 0	(+)90 0 0	(a)
3,150	3,500	192. Tuber crops Andhra.	3,465 0 0	(+)35 0 0	(a)
6,500	6,000	193. Tuber crops and related plants T. University.	6,000 0 0	..	
26,500	22,000	194. Tapioca and Sweet potato Travancore-Cochin.	21,971 2 8	(+)28 134	(a)

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
9,500	9,900	195. Improvement of vegetables Bombay.	9,804 0 0	(+) 96 0 0	(a).
14,900	16,900	196. Improvement of vegetables, U.P.	16,896 0 0	(+) 4 0 0	(a)
10,760	9,800	197. Improvement of vegetables, Pepsu.	9,800 0 0	..	
12,700	11,200	198. Improvement of vegetables Madras.	11,149 1 0	(+) 50 15 0	(a).
10,080	9,900	199. Improvement of vegetables, Kashmir	9,900 0 0	..	
7,200	5,700	200. Improvement of vegetables Punjab.	5,700 0 0	..	
9,900	10,300	201. Improvement of vegetables West Bengal.	10,243 10 0	(+) 56 6 0	(a)
9,000	14,500	202. Improvement of vegetables M.P.	14,500 0 0	..	
6,700	5,900	203. Improvement of vegetables V.P.	5,860 0 0	(+) 40 0 0	(a).
7,700	8,300	204. Improvement of vegetables H.P.	8,300 0 0	..	
..	200	205. Potato Breeding and Intermagnate Station for Potato Breeding, I.D.R.I.	107 5 0	(+) 92 11 0	(a)
..	4,300	206. Co-ordinated Scheme on the effect of chemicals on the storage of fruits and vegetables, Madras.	4,270 0 0	(+) 30 0 0	(a)
		(f) Other Crops			
3,600	4,000	207. Erget production, Assam	3,940 0 0	(+) 60 0 0	(a)
1,500	5,900	208. Turmeric, Orissa	5,870 0 0	(+) 30 0 0	(a)
15,800	11,900	209. Pepper, Madras	11,900 0 0	..	
..	2,600	210. Chillies, Madras	2,590 0 0	(+) 10 0 0	(a)
..	1,800	211. Cloves, Travancore.	1,762 0 0	(+) 38 0 0	(a)
1,700	1,700	212. Zira diseases, Rajasthan	1,650 0 0	(+) 50 0 0	(a)

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
11,200	6,000	213. Medicinal Plants, Assam	6,000 0 0	..	
21,300	8,800	214. Do. F.R.I.	8,770 0 0	(+) 30 0 0	(a)
10,700	11,100	215. Do. Kashmir	11,040 0 0	(+) 60 0 0	(a)
11,500	4,500	216. Do. West Bengal	14,460 0 0	(-) 9,960 0 0	(x)
5,300	3,000	217. Turmeric, Andhra	3,000 0 0	..	
5,900	4,000	218. Ginger Assam	4,000 0 0	..	
7,300	4,300	219. Chillies Andhra	4,226 0 0	(+) 74 0 0	(a)
3,300	5,600	220. Ergat production West Bengal	5,510 0 0	(+) 90 0 0	(a)
..	1,800	221. Investigation of insect infestation of pepper exported to U.S.A. Madras.	1,750 0 0	(+) 50 0 0	(a)
..	7,800	222. Foorkie Disease of cardamom, West Bengal	7,790 0 0	(+) 10 0 0	(a)
		(g) Soils and Manures			
..	8,700	223. Control of erosion, Visva Bharti Institute.	8,601 0 0	(+) 99 0 0	(a)
12,000	10,000	224. Soil standardisation method Bombay.	10,000 0 0	..	
5,100	3,900	225. Soil and Plant growth, Agra.	3,840 0 0	(+) 60 0 0	(a)
4,300	2,700	226. Nitrogen fixation in Soils, M.P.	2,628 0 0	(+) 72 0 0	(a)
19,000	2,200	227. Soil conservation, H.P.	2,160 0 0	(+) 40 0 0	(a)
1,200	13,200	228. Nitrogen fixation in Soils Sheila Dhar Institute.	13,200 0 0	..	
3,220	7,700	229. Rapid Soil Test, I.A.R.I.	7,640 0 0	(+) 60 0 0	(a)
1,960	20,000	230. Manurial experiments, Bombay	20,000 0 0	..	
1,350	24,900	231. Do. Pepsu	24,870 0 0	(+) 30 0 0	(a)

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
560	4,800	232. Manurial experiments, W. Bengal	4,714 13 5	(+)85 2 7	(a)
1,920	15,000	233. Do. Bihar	15,000 0 0	..	
1,600	14,900	234. Do. Punjab	14,900 0 0	..	
2,460	47,000	235. Do. Bhopal	47,000 0 0	..	
3,800	3,200	236. Green Manuring Crops, Bihar.	3,110 0 0	(+)90 0 0	(a)
7,900	7,000	237. Do C.R.R.I.	6,978 0 0	(+)22 0 0	(x)
8,700	4,000	238. Do I.C.J.C., Calcutta.	4,000 0 0	..	
3,600	2,600	239. Green manuring Crops, H.P.	2,526 0 0	(+)74 0 0	(a)
2,800	2,000	240. Do. Mysore	2,000 0 0	..	
7,200	6,000	241. Micronutrients status of Soils Bombay.	6,000 0 0	..	
1,020	13,200	242. Usarland declamation Sheilahdar Institute.	13,200 0 0	..	
21,900	19,400	243. Studies in microflora of Soils I.I.Sc. Bangalore.	19,306 0 0	(+)94 0 0	(a)
2,400	2,100	244. Azatobactor inoculation of crops, West Bengal.	2,100 0 0	..	
		(h) Agronomy			
3,600	3,200	245. Phenological observations, Poona.	3,126 0 0	(+)74 0 0	(a)
11,000	20,700	246. Water requirements of crops at Central Field Research Station Poona.	20,650 0 0	(+)50 0 0	(a)
..	100	247. Chemistry of Malting Choram, Madras.	73 12 0	(+)26 4 0	(a)
..	300	248. Supplement to the monograph on Dry farming in India, Bombay.	250 0 0	(+)50 0 0	(a)

APPENDIX XVI—*Contd.*

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
..	12,000	249. Model Agronomic Experiments, Other Centres	12,000 0 0	..	
		(i) <i>Physiology</i>			
..	2,100	250. Wheat physiology Delhi University	2,100 0 0	..	
..	6,400	251. Plant physiology Shri Boshi Sen Almora U.P.	6,382 7 5	(+)17 8 7	(a)
3,200	3,330	252. Cytological studies on crop plants Andhra University	3,300 0 0	(+)30 0 0	(a)
10,000	20,300	253. Use of phytohormones for higher yields Bombay	20,230 0 0	(+)70 0 0	(a)
10,000	7,500	254. Chemical Stimulation of ovules Delhi University	7,480 0 0	(+)20 0 0	(a)
10,700	53,000	255. Plant physiology and plant introduction U.P.	52,980 11 6	(+)19 4 6	(a)
..	460	256. Sub-station of plant introduction bureau U.P.	452 0 0	(+)0 8 0	(a)
		(j) <i>Entomology</i>			
..	400	257. Schools of research Entomology, Aligarh	396 0 0	(+)4 0 0	(a)
..	2,800	258. Weed Control, M.P.	2,800 0 0	..	
..	4,800	259. Do. Bhopal	4,794 0 0	(+)6 0 0	(a)
..	5,000	260. Do. H.P.	5,000 0 0	..	
..	2,200	261. Do. M. Bharat	2,200 0 0	..	
..	2,700	262. Do. Andhra	2,700 0 0	..	
1,970	12,700	263. Weed control, Poona	12,654 0 0	(+)46 0 0	(a)
70	3,000	264. Do. Madras	3,000 0 0	..	
1,500	15,000	265. Do. W. Bengal (Bose Inst).	15,000 0 0	..	

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
13,200	5,400	266. Termite Research F.R.I.	5,390 0 0	(+)10 0 0	(a)
3,310	6,700	267. Do. I.A.R.I.	6,700 0 0	..	
2,400	1,800	268. Do. Anand Institute.	1,730 0 0	(+)70 0 0	(a)
	100	269. Research on insecticides, Punjab	51 12 6	(+)48 4 0	(a)
2,680	3,600	270. Test with D.D.T. Bombay.	3,600 0 0	..	
		<i>k—Mycology</i>			
29,200	30,700	271. Virus diseases Poona.	30,684 0 0	(+)16 0 0	(a)
12,300	12,000	272. Do. Simla	12,000 0 0	..	
8,300	8,000	273. Do. Delhi	8,000 0 0	..	
..	..	274. Mycological and Entomological Investigation U.P.	9 0 0	(-)9 0 0	(a)
		<i>(l) General</i>			
30,500	22,400	275. Introduction of new economics plants I.A.R.I.	22,393 6 6	(+)6 9 6	(a)
1,660	200	276. Pre-soaking seeds in nutrient salts, Madras.	200 0 0	..	
10,500	7,400	277. Mechanism of polyploidy, Indore.	7,400 0 0	..	
			15,79,831-14-10		
		<i>(ii) Animal Husbandry</i>			
		<i>(a) Cattle Breeding</i>			
25,950	9,800	278. Livestock investigation Punjab.	9,744 8 0	(+)55 8 0	(a)
42,600	42,000	279. Improvement of Kangayam breed of cattle Madras.	42,000 0 0	..	
19,560	19,500	280. Evolving suitable draught capacity measure for bullocks, I.V. R. L.	19,500 0 0	..	

APPENDIX XVI—*Contd.*

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
26,000	24,000	281. Selective breeding and grading up of indigenous cattle, Orissa.	24,000 0 0	..	
6,910 (g)	5,700	282. Metabolic effects of hormones in relation to induced lactation, U. P.	5,700 0 0	..	
32,000	12,600	283. Physiological Genetics of Cattle West Bengal.	12,503 2 0	(+)96 14 0	(a)
..	16,000	284. Selective breeding and grading up of cattle, Orissa	16,000 0 0	..	
43,800	4,400	285. Artificial inoculation, I.D.R.I.	4,361 14 0	(+)38 2 0	(a)
38,400	8,000	286. Coordinated Cattle Sterility, I.V. R.I.	8,000 0 0	..	
14,000	5,600	287. Do. Madras	5,600 0 0	..	
18,860	10,800	288. Do. Bombay	10,800 0 0	..	
16,620	16,000	289. Do. U.P.	15,000 0 0	..	
15,141	10,000	290. Do. Bihar	10,000 0 0	..	
10,440	18,000	291. Cross breeding of Cattle, Andhra.	18,000 0 0	..	
11,500	16,300	292. Do. Madras	16,211 0 0	(+)89 0 0	(a)
10,620	100	293. Do. Assam	8 7 0	(+)91 9 0	(a)
11,120	24,100	294. Do. Bihar	24,050 0 0	(+)50 0 0	(a)
14,000	18,300	295. Cross breeding of Cattle, Punjab	18,240 0 0	(+)60 0 0	(a)
23,600	23,200	296. Do. Travancore Cochin.	23,200 0 0	..	
..	17,900	297. Do. Manipur	17,900 0 0	..	
		(b) Goat and Sheep Breeding			
..	..	298. Development of mutton breeds of sheep, Bombay.	342 0 0	(-)342 0 0	(x)
5,710	200	299. Goat Breeding, Punjab	105 2 3	(+)94 13 9	(a)

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
9,480	8,000	300. Sheep Research Station, Punjab.	8,000 0 0	..	
15,900	16,900	301. Sheep and wool improvement on regional basis U.P.	16,895 0 0	(+)5 0 0	(a)
36,090	10,400	302. Do. Bombay (Joris Centre).	10,366 0 0	(+)34 0 0	(a)
4,970	5,700	303. Do. Bihar	5,635 6 8	(+)64 9 4	(a)
7,940	7,100	304. Do. Madras	7,061 12 4	(+)48 3 8	(a)
18,420	10,000	305. Do. Rajasthan	10,000 0 0	..	
24,800	9,700	306. Do. H.P.	9,700 0 0	..	
10,150	2,200	307. Do. Jammu and Kashmir.	2,125 0 0	(+)75 0 0	(a)
..	12,020	308. Do. Bombay	12,000 0 0	(+)20 0 0	(a)
..	2,100	309. Soil Analysis on Sheep breeding, J. & K., I.A.R.I.	2,100 0 0	..	
..	10	310. A.D.I. (Sheep) Bihar.	5 4 0	(+)4 12 0	(a)
		(c) <i>Animal Nutrition</i>			
79,230	1,01,300	311. Animal Nutrition, Bombay.	1,01,300 0 0	..	
41,590	20,100	312. Do. I.D.R.I.	20,804 0 0	(+) 16 0 0	
	20,100	313. Do. West Bengal	19,920 0 0	(+)180 0 0	
32,000	9,000	314. Utilisation of waste products for feeding of cattle, Orissa.	9,000 0 0	..	
58,380	100	315. Further work on Paddy straw.	14 0 0	(+)86 0 0	(a)
..	1,000	316. Standardisation of rations or ryots cattle, Orissa.	922 0 0	(+)78 0 0	(a)
		(d) <i>Animal Pests Diseases and Cure</i>			
4,150	2,800	317. Veterinary investigation officer (cattle) Travancore Cochin.	2,730 0 0	(+)70 6 0	(a)
18	9,000.	318. Do. Assam	8,985 0 0	(+)15 0 0	(a)

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
4,880	3,000	319. Vetarinary investigation offices (cattle) Pepsu.	3,000 0 0	..	
12,150	6,000	320. Do. Rajasthan	6,000 0 0	..	
8,040	3,500	321. Do. Mysore	3,500 0 0	..	
..	900	322. V.L.O. (Sheep & Goats) Madras.	832 0 0	(+)68 0 0	(a)
4,120	4,000	323. Do. Hyderabad	3,956 2 7	(+)43 13 5	(a)
5,840	4,700	324. Do U.P.	4,700 0 0	..	
54,640	6,000	325. Tuberculosis & Johne's disease among animals I.V.R.I.	5936 0 0	(+)64 0 0	
31,210	100	326. Helminth Parasites I.V.R.I.	9 0 0	(+)91 0 0	(a)
13,070	12,800	327. Parasite disease Mysore.	12,800 0 0	..	
5,730	4,000	328. Fluke disease of bovine, Bombay.	4,000 0 0	..	
14,680	8,000	329. Inrestigation of infections abortion (Brucella-sis) U.P.	8,000 0 0	..	
4,660	3,900	330. Control eradicating of stephona-fill arises among cattle Orissa.	3,880 0 0	(+)20 0 0	(a)
10,480	4,400	331. Do. Assam	4,350 0 0	(+)50 0 0	(a)
..	5,500	332. Do. W. Bengal	5,500 0 0	..	
20,350	11,000	333. Tuberculin testing Madras	11,000 0 0	..	
29,020	24,300	334. Bearing of nutrition on helminthic infection, I.V.R.I.	24,216 0 0	(+)84 0 0	(a)
2,240	6,500	335. Control of bovine Pleuro-Pneumonia—Assam.	6,450 0 0	(+)50 0 0	(a)
7,000	4,400	336. Contagious caprine pleuropneumonia I.V.R.I.	4,400 0 0	..	
		337. Lumber paralysis in goats, Orissa.			

APPENDIX XVI—*Contd.*

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
6,450	4,100	338. Investigation of mastitis, Bombay.	4,884 12 0	(+) 15 4 0	(a)
8,470	12,600	339. Do. I.V.R.I.	13,600 0 0	..	
1,500	4,000	340. Do. Punjab	4,000 0 0	..	
4,000	3,100	341. Do. Mysore	3,100 0 0	..	
		(e) <i>Dairying</i>			
..	14,000	342. Study on development of dairy for use in organised villages milk producing and milk handling trends, I.D.R.I.	14,000 0 0	..	
	16,000	343. Scheme for the study of pasturing of Rilyghaictsstepidegt pation	16,000 0 0	..	
..	50	344. Survey of Bacteriological quality of Marketing Milk I.D.R.I., Lucknow.	23 10 0	(+) 26 6 0	(a)
22,600	17,000	345. Production of dehydrated powder and edible casein I. D.R.I.	17,000 0 0	..	
		(f) <i>Wool</i>			
1,930	2,400	345A. Wool Analysis—Bihar.	2,400 0 0	..	
..	6,700	346. Cost of production of sheep wool, Poona.	6,670 2 6	(+) 29 13 6	(a)
		(g) <i>Skins & Hides</i>			
20,31(CK)	18,000	347. Chemistry of mineral tannages, C.L.R.I.	18,000 0 0	..	
12,390	15,800	348. Manufacture of fat liquors C.L.R.I.	15,800 0 0	..	
8,000	7,000	349. Manufacture of Chrome retan leather C.L.R.I.	7,000 0 0	..	
3,540	5,700	350. Manufacture of leather boards C.L.R.I.	5,680 0 0	(+) 20 0 0	(a)

APPENDIX XVI—*Contd.*

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
		(h) <i>Poultry</i>			
4,260	3,000	351. Influence of climate on performance of Desi fowl, Orissa.	3,000 0 0	..	
..	4,000	352. Laying trials of Poultry I.V.R.I.	4,000 0 0	..	
7,600	1,000	353. Coccidiosis in Poultry I.V.R.I.	1,000 0 0	..	
..	4,700	354. Poultry research M.P.	4,674 0 0	(+)26 0 0	(a)
9,900	7,400	355. Do. Travancore-Cochin.	7,400 0 0	..	
5,900	3,200	356. Immunization of village poultry against Ranikhet diseases—Bombay.	3,200 0 0	..	
2,430	4,300	357. Helminth parasites affecting poultry, I.V.R.I.	4,300 0 0	..	
5,240	3,500	358. Duck breeding Travancore-Cochin.	3,420 0 0	(+)80 0 0	(a)
		(i) <i>Fish</i>			
..	3,300	359. Piscicultural Research Annamalli Univ.	3,256 0 0	(+)44 0 0	(a)
6,300	5,200	360. Processing of unpopular fish W. Bengal.	5,200	..	
6,700	3,900	361. Fish Fauna and ecology of food fishes.	3,870 0 0	(+)30 0 0	(a)
8,040	5,600	362. Regional Bee-research Station—Madras.	5,585 1 6	(+)14 14 6	(a)
		(j) <i>Miscellaneous</i>			
..	5,400	363. Using Cow for work I.V.R.I.	5,400 0 0	..	
4,330	2,400	364. Post graduate course in parasitology—Madras.	2,400 0 0	..	

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
		(iii) Combined Agriculture and Animal Husbandry Schemes			
		(a) Development			
..	4,200	365. Village projects Bombay (Baroda)	4,195 0 0	(+)5 0 0	(a)
..	7,100	366. Production and trial of Agriculture Implements	7,020 0 0	(+)80 0 0	(a)
1,000	2,900	367. Refresher Course in Agri. for young farmers Madras & Andhra.	2,900 0 0	..	
	1,100	368. Do. Amravati	1,030 0 0	(+)70 0 0	(a)
..	7,600	369. Do. Hyderabad	7,600 0 0	..	
	600	370. Training Centres on Japanese method of paddy cultivation—Bombay	550 0 0	(+)50 0 0	(a)
6,000	28,000	371. Institution of junior and Senior fellowships for post graduate and Ph. D. degree in various agricultural sciences various centres.	2,744 8 0	(+)55 0 0	(a)
..	12,400	372. Survey of indigenous implements, Madras.	12,390 0 0	(+)10 0 0	(a)
..	13,000	373. Do. U.P.	13,000 0 0	..	
	8,800	374. Do. Punjab.	8,740 0 0	(+)40 0 0	(a)
	13,000	375. Do. Bomaby	13,000 0 0	..	
..	17,000	376. Survey of indigenous implements, Assam.	17,000 0 0	..	
..	4,800	377. Do. M.P.	4,800 0 0	..	
..	7,300	378. Do. W. Bengal	7,900 0 0	..	
..	9,800	379. Do. Orissa	9,780 0 0	(+)20 0 0	(a)
..	1,900	380. Do. Hyderabad	1,850 0 0	(+)50 0 0	(a)
..	4,640	381. Do. M.B.	4,640 0 0	..	
..	10,000	382. Do. Mysore	10,000 0 0	..	

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
..	16,000	383. Do. Rajasthan	16,000 0 0	..	
..	3,400	384. Survey of indigenous implements Travancore-Cochin.	3,400 0 0	..	
..	1,700	385. Do. Pepsu.	1,700 0 0	..	
..	300	386. Do. Bhopal	226 0 0	(+)74 0 0	(a)
..	7,000	387. Do. Coorg	7,000 0 0	..	
..	18,300	388. Do. V.P.	16,290 0 0	(+)10 0 0	(a)
2,170	2,100	389. Training in Village blacksmiths—Hyderabad.	2,100 0 0	..	
..	500	390. Commercial Production of Ovules, Delhi, University.	420 0 0	(+)72 0 0	(a)
		(v) <i>Miscellaneous Schemes</i>			
7,120	10,300	391. Nature and Extent of Non-farm Employment in rural areas of Gujarat in Bombay State Bombay.	10,300 0 0	..	
..	6,000	392. Livestock & Fisheries Statistics Travancore-Cochin.	6,000 0 0	..	
..	200	393. Do. Bihar	137 0 0	(+)62 8 0	(a)
..	24,000	394. Do. Bombay	24,000 0 0	..	
4,000	2,000	395. Award of research fellowship for the economics of multipurpose river valley projects in India Delhi, Univ.	2,000 0 0	..	
28,600	22,600	396. Commonwealth Agriculture Bureau. Imperial Institute of Mycology. Imperial Institute of Entomology. Farnham House Laboratory. Imperial Bureau of Dairy Science. Fruit Preservation Research Station Campden.	28,560 0 0	(+)40 0 0	(a)

APPENDIX XVI—*Contd.*

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
		Pt. II <i>New Schemes</i>			
		B.— <i>Grants-in-aid</i>			
		(i) <i>Agriculture</i>			
..	5,000	397. Drought resistant strains of paddy Madras.	4,930 0 0	(+)70 0 0	(a) Rice.
..	5,700	398. Rice Physiology Calcutta University.	5,650 0 0	(+)50 0 0	(a)
..	6,000	399. Deep Water paddy Andhra.	6,000 0 0	..	
..	2,400	400. Rice Stem borer—Madras.	2,240 0 0	(+)60 0 0	(a)
..	9,190	401. Do. West Bengal	9,080 0 0	(+)110 0 0	(a)
..	3,500	402. Do. Andhra	3,440 0 0	(+)60 0 0	(a)
..	2,400	403. Stem rot disease of Rice—Madras.	2,372 8 0	(+)27 8 0	(a)
..	9,800	404. Hybrid — Maize Bombay.	9,800 0 0	..	
..	6,000	405. Disease of bajra Anand Institute.	6,000 0 0	..	
..	400	406. Blast Foot Rot disease—Madras.	379 10 0	(+)20 6 0	(a)
..	3,100	407. Alkali reclamation Andhra.	3,100 0 0	..	
..	2,300	408. Legume Seed inoculation do.	2,220 0 0	(+)80 0 0	(a)
..	1,500	409. Research on Cashewnuts Andhra.	1,450 0 0	(+)50 0 0	(a)
..	4,000	410. Cytogenetical Investigation of fruit trees Cal. Univ.	4,000 0 0	..	
..	1,300	411. Chillies Research Scheme I. I.A.R.I.	1,300 0 0	..	
..	3,300	412. Spices Scheme W. Bengal.	3,200 0 0	..	
..	3,000	413. Clove nuturegated coca Scheme Madras.	3,000 0 0	..	

APPENDIX XVI—*Contd.*

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
..	6,700	414. Botanical Improvement of essential oils I.A.R. I. Pusa.	6,700 0 0	..	
..	5,600	415. Coordinated plants virus Scheme Eastern Zone, I.A.R.I.	3,600 0 0	..	..
..	11,800	416. Survey of indigenous Agriculture Implements, Andhra.	11,740 0 0	(+)60 0 0	(a)
..	8,000	417. Model Agronomic Experiments Madras.	8,000 0 0	..	
..	10,000	418. Do. PEPSU.	10,000 0 0	..	
..	7,000	419. Do. Punjab.	7,000 0 0	..	
..	8,000	420. Do.	8,000 0 0	..	
..	10,000	421. Do. Andhra.	10,000 0 0	..	
..	10,000	422. Do. Travancore-Cochin.	10,000 0 0	..	
..	4,000	423. Sugarcane Production Andhra.	4,000 0 0	..	
..	1,100	424. Sugarcane production PEPSU.	1,100 0 0	..	Misc.
..	4,000	425. Sugarcane production Bombay.	4,000 0 0	..	"
..	800	426. Sugarcane production Madras.	800 0 0	..	"
..	4,500	427. Sugarcane production Punjab.	4,500 0 0	..	"
..	2,000	428. Sugarcane production Hyderabad.	2,900 0 0	..	"
..	3,500	429. Sugarcane production Madhya Pradesh.	3,500 0 0	..	"
..	13,500	430. Pilot Sample Survey pepper Madras.	13,430 0 0	(+) 80 0 0	"

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
..	13,100	431. Pilot Sample Survey pepper Travancore-Cochin.	13,000 0 0	(+) 10 0 0	Misc.
..	30,000	432. Development of pepper Madras.	30,000 0 0	..	Other Crops
..	2,600	433. Cashewnut Madhya Pradesh.	2,500 0 0	..	Fruits
..	2,900	434. Pulse breeding Madhya Bharat (Gwalior).	2,835 0 0	(+) 65 0 0	(a) Millet and Pulses.
..	3,900	435. Survey of fertilizer practices Bihar.	3,900 0 0	..	Soils and Manure
..	10,000	436. Scheme on Method and Practices of Farm Accounts, both the Institute of Politics Poona.	10,000 0 0	..	
..	36,000	437. Selective A. H. Schemes breeding and grading up of cattle West Bengal.	36,000 0 0	..	(a) Cattle Breeding
..	6,100	438. Physiological horns of Indian Cattle, West Bengal.	6,090 0 0	(+) 10 0 0	„
..	6,000	439. Goat Breeding Uttar Pradesh.	6,000 0 0	..	(b) Govt.
..	8,200	440. Goat Improvement West Bengal.	8,120 0 0	(+) 80 0 0	(a)
..	25,700	441. Nutrition requirements of buffaloes, Agra.	25,700 0 0	..	
..	2,200	442. Study of the bacteriological flora in bovine and their treatment and control Orissa.	2,200 0 0	..	(d)
..	3,600	443. Detection of adulteration and estimation of main constituents of milk, Punjab Uty.	3,600 0 0	..	(d)

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
..	31,900	444. Bacteriological quality of milk Kaisra, District, Anand.	31,870 0 0	(+) 30 0 0	(a)
..	2,000	445. I. D. I. O. Poultry Andhra.	2,000 0 0	..	(b)
..	46,000	446. Poultry development American Mission Madras.	45,958 0 0	(+) 42 0 0	(a) (b)
..	58,000	447. Do. Travancore-Cochin.	58,000 0 0	..	(b)
..	9,000	448. Improvement in craft and tackle for inland and Esturine in fishing, Orissa.	9,000 0 0	..	
..	5,000	449. Pilot Survey in inland fisheries Hyderabad.	5,000 0 0	..	Misc.
			2,39,538 0 0		
		<i>E—Debts and Remittances</i>			(a) Inconsiderable.
		(1) <i>Loan and Advances</i>			
3,000	6,900	Advances paid to the Staff for the purchase of Cycles, motor cycles and motor Car.	6,820 0 0	(+) 80 0 0	(a)
		<i>Deposits and Advances Repayable :</i>			
		(a) <i>Deposits of I. C. A. R. Provident Fund:</i>			
		(i) Advances from subscription	10,629 0 0		
		(ii) Repayment of subscription.	22,931 9 0		
		(iii) Repayment of Council's Contribution	7,813 0 0		
		(iv) Payment of Interest.	1,726 13 0		
1,00,000	10,900	(v) Suspense	..	10,115 9 3	(a)
		(vi) Miscellaneous	0 1 0	(+) 784 6 9	

APPENDIX XVI—Contd.

1	2	3	4	5	6
Rs.	Rs.		Rs. A. P.	Rs. A. P.	
		(b) <i>Other Deposits and Advances Repayable :</i>			
		(i) Library Deposit	..		
		(ii) Permanent Advance	..		
		(iii) Caution money Repayable.	..		
		(iv) Suspense	—33,196 12 9		
		(v) Other Deposits and Advances.	211 15 0		
		(c) <i>Payment of Income-tax Provident Fund etc.:</i>			
		(i) Income-tax	4,271 3 0		
		(ii) G. P. Fund	4,296 0 0		
		(iii) Contributory Provident Fund.	231 9 0		
		(iv) Miscellaneous Recoveries	6,811 8 0		
		(v) Postal Life Insurance.	126 0 0		
36,790	24,000	(vi) Payment of I.C.A.R. Provident Fund.	7,792 1 8 23,528 5 8		
		Total expenditure Investment and Re-investment	53,86,619 10 7	(+) 471 10 4	(a)
		Repayment of unspent balances.	45,70,000 0 0 68,606 9 10		
		<i>Closing Balances :</i>			
		(i) Cash in hand	14,171 2 9		
		(ii) Bank	12,32,425 8 7		
		(iii) Provident Fund	35,190 7 5		
				12,81,787 2 9	
				113,07,013 7 2	

Verified and found

Correct.

(Sd.)— I. S. SHARMA

Asstt. a/c. Officer./O.A.L.(c).

Attested True Copy

N. BOSE, 15-6-57

Supdt./O.A.D(c).

(Sd.)—

(Ajudhia Prasada)

Under Secretary

